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(54) **Data conversion method and recording/reproducing apparatus using the same.**

(57) A data conversion method, wherein a sequence of first r-bit datawords is divided into groups of x bits where x is the least common multiple of r and m, an arbitrary first dataword selected from x/r groups of first datawords is divided into x/m, an m-bit second dataword is formed by appending r/(x/m)-bit data, obtained by dividing the first dataword into x/m, to the LSB or MSB side of one or other of the non-divided first datawords, and the word-converted m-bit second dataword is converted to an n-bit codeword (m < n).

EP 0 557 130 A2

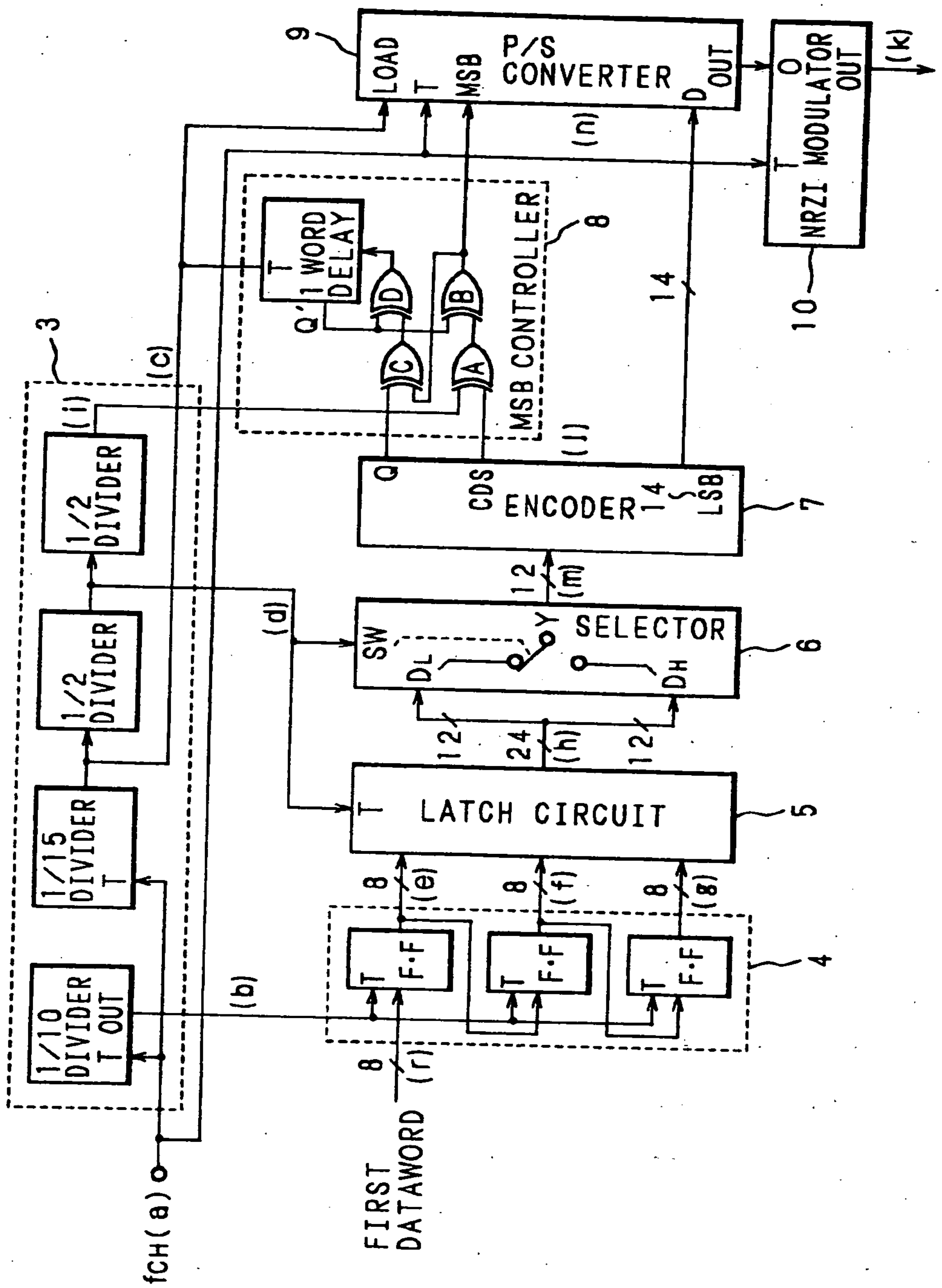

9
P/S CONVERTER
LOAD
T
MSB
D
OUT
(n)
NRZI MODULATOR
T
O
OUT
(k)
10
8
MSB CONTROLLER
1 WORD DELAY
T
Q'
A
B
C
D
14
3
(c)
(i)
(l)
Q
CDS
ENCODER
14
LSB
7
1/2 DIVIDER
1/2 DIVIDER
1/15 DIVIDER
T
1/10 DIVIDER
T OUT
(d)
SW
SELECTOR
DL
DH
Y
6
12
(m)
12
24
(h)
12
T
LATCH CIRCUIT
5
8
(e)
8
(f)
8
(g)
T
F·F
T
F·F
T
F·F
4
(b)
8
(r)
FIRST DATAWORD
fCH(a)

Fig. 27

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a data conversion method for converting digital data to signals suitable for the recording system or' the transmission channel used when recording or transmitting the digital data onto magnetic tape, and a recording/reproducing apparatus employing the data conversion method.

Description of Related Art

Prior art data conversion methods employed in magnetic recording/reproducing apparatus include, for example, an 8/10 modulation method such as disclosed in "THE DAT CONFERENCE STANDARD" (issued June 1987). The 8/10 modulation method is a data conversion method in which digital data are partitioned into datawords of 8 bits each for conversion into 10-bit codewords. Fig. 1 is a circuit block diagram for explaining this data conversion method, and Fig. 2 is a data conversion table used for the same. In Fig. 1, the reference numeral 1 designates an encoder for accepting eight-bit digital data and a one-bit table select signal (Q') at its respective inputs and for outputting a total of 11 bits, i.e. a 10-bit codeword plus a one-bit signal (Q) for selecting the table for the next codeword. Further, the numeral 2 denotes a flip-flop for delaying the codeword table select signal by one dataword. The encoder 1 includes a read-only memory (ROM) or the like which contains the data conversion table shown in Fig. 2, wherein codewords of CDS (Codeword Digital Sum) = 0 are mapped on a one-to-one basis to 256 datawords from "00" to "FF" of hexadecimal numeral, while in the case of codewords of CDS ≠ 0, pairs of codewords, one with CDS = +2 and the other with CDS = -2, are each mapped to one dataword, the table of Q' = -1 consisting of codewords of CDS = +2 and the table of Q' = +1 consisting of codewords of CDS = -2. The table select signal (Q) is used to select the CDS (the table) having the direction that suppresses the dispersion of charges in the codeword sequence.

The operation of the above circuit will now be explained with reference to the timing diagram of Fig. 3. In Fig. 3, the reference signs (a), (Q), and (b) correspond to inputs/outputs at the respective parts shown in Fig. 1, and the reference signs (c) and (d) respectively represent an output signal from an NRZI converter (not shown) and a DSV (Digital Sum Variation) value at the end of codeword.

First, an eight-bit dataword "FF" is input to the encoder 1, along with the table select signal (Q') = -1, and consequently, the encoder 1 outputs a 10-bit codeword "1111101010" of CDS = +2 corresponding to "FF" for Q' = -1. At the same time, the table select signal Q = -1 is output for the next codeword. The parallel 10-bit signal is then converted to a serial signal, after which the signal is NRZI-modulated. As a result, the DSV value at the end of the codeword becomes +2.

Next, when "00" is input to the encoder 1, the encoder 1 outputs Q = 1 together with a 10-bit signal "0101010101" of CDS = 0 corresponding to "00" for Q' = -1 which is produced by introducing a one-symbol delay in the previous output Q = -1. As a result, the DSV value at the end of the codeword after NRZI modulation remains at +2.

Next, when "11" is input to the encoder 1, the encoder 1 outputs Q = -1 together with a 10-bit signal of CDS = -2 corresponding to "11" for Q' = 1. As a result, the DSV value at the end of the codeword after NRZI modulation becomes zero. In this manner, for each eight-bit dataword input to the encoder 1, a codeword to be output is selected from the table of either Q' = -1 or Q' = 1 corresponding to the dataword on the basis of the table select signal output previously. The DSV at the end of each codeword after NRZI modulation can only take the value 0, +2 or -2. This means that the DSV dispersion is suppressed, as a result of which DC-free data conversion is realized.

As described above, according to the prior art data conversion method, eight-bit data is converted to a 10-bit codeword of CDS = 0 or CDS = +2 or -2, and a DC-free signal is produced with the DSV dispersion suppressed, thereby minimizing intersymbol interference on the transmission channel and thus increasing the recording density per track. However, for recent digital magnetic recording/reproducing apparatus using a rotary head, a recording density as high as several square micrometers per bit is demanded, which necessitates not only increasing the recording density per track but also reducing the track width down to several micrometers. To implement such apparatus, it is essential to employ a dynamic tracking following (DTF) control system whereby pilot signals for tracking are recorded on the main track recorded by the rotary head and the playback head is controlled to follow the recorded track curves during playback. When the prior art data conversion method is employed in such apparatus for multiplex recording of the pilot signals, the digital signal spectral distribution has to be obtained down to ultra low frequency ranges although the recorded information signals contain no DC components; the resulting problem is that the pilot signals cause external disturbances, leading to increased errors in the detection of the digital signals.

One possible approach to overcoming the problem of the pilot signals causing external disturbances to the digital signals may be by generating pilot signals synchronized to the digital signals. However, the prior art data conversion method is effective only in suppressing the DSV dispersion and is not capable of actively controlling the DSV, and therefore, has the problem that it cannot generate pilot signals syn-

chronized to the digital signals.

Fig. 4 shows a DAT recording format employed in a magnetic recording apparatus using the 8/10 modulation method. As shown, according to the format of Fig. 4, ATF areas for tracking control are provided in each of which a pilot signal for tracking control is recorded. Further, Fig. 5 shows a digital VTR recording format which is disclosed in Japanese Patent Application Laid Open No.3-217179 (1991). As shown, the track is divided into a video data area, an audio data area, a servo pilot area, and a sub code area, the pilot signal being recorded in the servo pilot area only.

According to the above construction of the prior art, it is not possible to control the DSV in such a manner as desired, and a separate area has to be reserved for recording a pilot signal for tracking control. Accordingly, accurate tracking control cannot be realized without increasing the data amount and hence increasing the recording rate, which makes it difficult to achieve high density recording.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a data conversion method which, by suppressing low frequency components, can minimize intersymbol interference on the transmission channel, thus permitting increased per-track recording density, as in the prior art data conversion method, and which is capable of generating pilot signals synchronized to digital signals, which has not been possible with the prior art method, and thus achieves increased recording density with reduced track width.

It is another object of the present invention to provide a recording/reproducing apparatus optimized for the data conversion method capable of generating pilot signals synchronized to digital signals.

It is a further object of the present invention to provide a data conversion method which is capable of generating pilot signals for tracking control and which involves hardly any increase in the recording rate and therefore permits high density recording, and a recording/reproducing apparatus using such a data conversion method.

According to the present invention, there is provided a data conversion method for word-converting an r-bit first dataword to an m-bit second dataword (r < m) and converting the word-converted m-bit second dataword to an n-bit codeword (m < n), in which, for r/m word-conversion, a sequence of first datawords is divided into groups of x bits where x is the least common multiple of r and m, an arbitrary first dataword selected from x/r groups of first datawords is divided into x/m, and r/(x/m)-bit data obtained by dividing the first dataword into x/m is appended to the LSB (or MSB) side of one or other of the non-divided first datawords to form the m-bit second dataword. The m-bit second dataword can thus be handled as r + (r/(x/m)) (or (r/(x/m)) + r). Therefore, if, in m/n conversion, the n-bit codeword is formed by dividing it into n1 and n2 bits, the data conversion can be performed by relating r to n1 and r/(x/m) to n2. This serves to reduce the possibility of error propagation due to a bit error that may occur in reverse data conversion.

Furthermore, when converting the word-converted m-bit second dataword to the n-bit codeword, the number of successive 0s between a bit "1" and the next bit "1" in each n-bit codeword is limited to 4, and two codewords, one with CDS = +1 and the other with CDS = -1, are paired and related to the m-bit second dataword, the two codewords being selectively used in accordance with a DSV control signal. This enables the DSV to be controlled at a desired value for each codeword, thereby achieving spectrum suppression in a relatively low frequency range. Also, by controlling the CDS polarity in accordance with the DSV control signal, a pilot signal of the DSV variation cycle synchronized to digital data can be generated in the low frequency band where the digital data power spectrum exhibits an abrupt drop.

When the above data conversion method is employed in a recording/reproducing apparatus, the number of first datawords to be recorded in a data block where an error-correcting code and an error-detection code are appended for every synchronizing signal is set at an integral multiple of x/r. The recording/reproducing apparatus thus constructed achieves an efficient code format that does not require redundant bits.

The recording/reproducing apparatus employing the above data conversion method has: decoding means for decoding n1 bits in the reproduced n-bit codeword into r bits, the reproduced n-bit codeword being divided into n1 bits and n2 bits for reverse conversion into the m-bit second dataword; decoding means for decoding the n2 bits into r/(x/m) bits; decoding means for decoding the n bits into the m bits; identifying means for identifying the type of bits at prescribed positions in the n-bit codeword and for outputting an identification signal designating the identified type; and means for selecting decoded data from the respective decoding means on the basis of the identification signal supplied from the identifying means and for outputting the decoded second dataword. This construction serves to reduce the possibility of the error propagation that may occur between decoded first datawords due to a single bit random error in the n-bit codeword.

Another recording/reproducing apparatus of the invention has: means for recording multiple kinds of data in partitioned areas; means for relating 14-bit codewords of CDS = 0 and pairs of codewords of CDS = ± 2 to respective 12-bit datawords when encoding and recording at least one of the multiple kinds of data and for encoding the data by selectively using these

codewords; and means for appending one bit to each 14-bit codeword to form a pair of codewords, one with CDS = +1 and the other with CDS = -1, when encoding and recording at least one other of the multiple kinds of data and for encoding the data by selectively using these codewords.

In the above recording/reproducing apparatus, when encoding and recording at least one of the area-partitioned multiple kinds of data, either a 14-bit codeword of CDS = 0 or a pair of codewords differing only in MSB, one with CDS = +2 and the other with CDS = -2, are related to one dataword, and the dataword is encoded by selectively using these codewords, thus constructing a DC-free code of Tmin = 0.86T and Tmax = 4.29T; on the other hand, when encoding and recording at least one other of the multiple kinds of data, one bit is appended to each 14-bit codeword to form a pair of codewords, one with CDS = +1 and the other with CDS = -1, and the data is encoded by selectively using these codewords, thus constructing a code that provides the DSV coming round to the same value at prescribed intervals.

The above and further objects and features of the invention will more fully the apparent from the following detailed description with accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing the circuit configuration of a prior art data converting apparatus.

Fig. 2 is a code conversion table according to a prior art data conversion method.

Fig. 3 is a diagram for explaining the operation of the data converting apparatus of Fig. 1.

Fig. 4 is a diagram showing a recording format of a prior art DAT.

Fig. 5 is a diagram showing a recording format of a prior art digital VTR.

Figs. 6 is a diagram showing the number of codewords for deriving codewords in accordance with a first embodiment of the invention.

Figs. 7 is a diagram showing the number of codewords for deriving codewords in accordance with a first embodiment of the invention.

Figs. 8 is a diagram for explaining the construction of code conversion tables according to the first embodiment of the invention.

Figs. 9 is a diagram for explaining the construction of code conversion tables according to the first embodiment of the invention.

Figs. 10 is a diagram for explaining the construction of code conversion tables according to the first embodiment of the invention.

Figs. 11 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 12 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 13 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 14 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 15 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 16 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 17 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 18 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 19 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 20 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 21 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 22 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 23 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 24 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 25 is a diagram showing code conversion according to the first embodiment of the invention.

Figs. 26 is a diagram showing code conversion according to the first embodiment of the invention.

Fig. 27 is a diagram showing the circuit configuration of a data converting apparatus for implementing the code conversion method of the first embodiment.

Fig. 28 is a diagram for explaining the operation of the data converting apparatus of Fig. 27.

Fig. 29 is a power spectrum diagram showing the effect of the first embodiment.

Fig. 30 is a diagram showing the structure of a first dataword block recorded by a recording/reproducing apparatus employing the data conversion method of the first embodiment.

Fig. 31 is a diagram showing the structure of the first dataword block recorded by the recording/reproducing apparatus employing the data conversion method of the first embodiment along with the structure of the first datawords recorded at the top of the block.

Fig. 32 is a diagram showing the configuration of a circuit for implementing a decoding method in the recording/reproducing apparatus employing the data conversion method of the first embodiment.

Fig. 33 is a diagram showing classifications for 5-bit LSB codewords in the codewords of the first embodiment.

Figs. 34 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 35 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 36 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 37 is a diagram showing code conversion

according to a second embodiment of the invention.

Figs. 38 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 39 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 40 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 41 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 42 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 43 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 44 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 45 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 46 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 47 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 48 is a diagram showing code conversion according to a second embodiment of the invention.

Figs. 49 is a diagram showing code conversion according to a second embodiment of the invention.

Fig. 50 is a diagram showing the circuit configuration of a data converting apparatus for implementing the data conversion method of the second embodiment.

Fig. 51 is a diagram showing a code select table according to the second embodiment.

Fig. 52 is a diagram for explaining the operation of the data converting apparatus of Fig. 50.

Fig. 53 is a diagram showing a recording format of a recording/reproducing apparatus according to the second embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Embodiment 1)

A first embodiment of the invention will now be described below with reference to accompanying drawings. Now suppose a first dataword length r = 8, a word-converted second dataword length m = 12, and a data-converted codeword length n = 15, to form a code with a modulation parameter Tmax/Tmin = 5. At this time, d = 0 and k = 4, where d is the minimum number of 0s between an arbitrary 1 and the next 1, and k is the maximum number of 0s between an arbitrary 1 and the next 1. The NRZI (F) rule is used to form the code. To achieve such a data conversion, the maximum number of successive 0s in each codeword is limited to 3 on the MSB side, 1 on the LSB side, and 4 within codeword. In this situation, the number of possible codewords having the MSB of 0 and satisfying the 0 run length condition is given in Fig. 6 for each CDS.

To form a DC-free code, 2^{12} pairs (4096 pairs) of codewords, each pair having codewords of different CDS polarities, should be provided. The numbers given in Fig. 6 are only for codewords whose MSB is 0; by converting the MSB to 1, codewords of reverse CDS polarity can be obtained while satisfying the 0 run length condition. Accordingly, of the codewords given in Fig. 6, only the codewords of CDS = ± 1 are enough to satisfy the minimum required number of second datawords = 2^{12} (4096 < number of codewords = 4650). Therefore, by using only the codewords of MSB = 0 and CDS = ± 1 and by setting the MSB to 0 or 1, it is possible to suppress the dispersion of DSV.

Fig. 7 shows possible combinations of codewords n1 and n2 when the codewords of CDS = ± 1 given in Fig. 6 are each divided into n1 = 10 bits and n2 = 5 bits, n1 representing the 10 bits on the MSB side and n2 representing the 5 bits on the LSB side. In Fig. 7, Group A consists of n1 codewords of CDS = 0, Group B of n1 codewords of CDS = +2, Group C of n1 codewords of CDS = -2, Group D of n1 codewords of +4, and Group E of n1 codewords of CDS = -4. Each of the codeword groups A to E is subdivided in accordance with the 0 run length at codeword end resulting from the concatenation of the codewords n1 and n2.

First, we focus our attention on Group A. It can be seen that there are 18 different n2 codewords that can be paired with A1 while, of the 18 codewords, 17 codewords excluding the codeword "02" can also be paired with A2. Therefore, for Group A, 16 codewords, excluding the codewords "02" and "05", are used, and m = 12 bits are divided into m1 = 8 bits and m2 = 4 bits at the time of m/n conversion, to realize m1/n1 (8/10) conversion and m2/n2 (4/5) conversion, respectively. This coding technique serves to avoid propagation of errors between divided codewords at the time of decoding. To utilize this property, when 8-bit first datawords of length (r) supplied from an error-correcting circuit are word-converted to 12-bit second datawords of length (m), four bits separated from the eight bits are mapped to m2, while non-divided 8 bits are mapped to m1. As a result, when a random error occurred to one bit in n bits during the reconstruction process, the error occurring to the first dataword after decoding is limited only to one dataword; the error is thus prevented from propagating between datawords.

In the first embodiment, 1s and 0s used to represent one-bit signals are binary numbers, a 1 representing a high level and a 0 a low level. On the other hand, "0" to "F" used to represent datawords, codewords, or parallel data bit sequences are hexadecimal numbers.

If the above coding method is provided in 256 pairs, a single bit error in n bits during the reconstruction process can be prevented from propagating be-

tween first datawords after decoding. However, as is apparent from Fig. 7, under the condition that satisfies the modulation parameter of the data conversion method of the first embodiment, the above coding method can be applied only to Group A, and cannot be applied to the other Groups B to E.

In view of the above situation, we now consider a method of coding, as shown in Figs. 8 to 10 wherein the m1/n1, m2/n2 coding method is divided into three major coding groups, i.e. the first coding group consisting only of Group A codewords corresponding to the first datawords m1 = "00" to "73", the second coding group consisting of Group B and Group C codewords corresponding to the first datawords m1 = "74" to "BA", and the third coding group consisting of the codewords in the other groups as well as the remaining codewords in Group B and Group C corresponding to the first datawords m1 = "BB" to "FF".

First, referring to the first coding group of Fig. 8 which consists only of Group A codewords, if an error occurred to one bit in n bits in the reconstruction process, the error occurring to the first dataword after decoding is limited only to one dataword and is thus prevented from propagating between datawords.

Next, in the second coding group shown in Fig. 9, there is provided a one-to-one correspondence for the m2/n2 conversion, but for the m1/n1 conversion, two n1 codewords are mapped to one m1. Therefore, of the encoded 15 bits, if the 10 bits mapped to n1 contains a single bit error, the error occurring to the first dataword after decoding is limited only to one dataword and is thus prevented from propagating between datawords. However, if there is an error in one bit out of the five bits mapped to n2, error propagation can occur between first datawords after decoding from the probability point of view.

Further, in the third encoding group shown in Fig. 10, one m1 is mapped to a plurality of n1 codewords for the m1/n1 conversion, while for the m2/n2 conversion, a plurality of m2 codewords are mapped to one n2. Therefore, any one bit error can cause error propagation between first datawords after decoding from the probability point of view whether the error is in n1 or n2.

In the data conversion method wherein an 8-bit first. dataword is word-converted to a 12-bit second dataword which is further converted to a 15-bit codeword, the above coding method has the effect of reducing the possibility of error propagation that may occur between first datawords after decoding due to a single bit detection error in the encoded 15 bits.

Code conversion tables thus constructed are shown in Figs. 11 to 26. The numbers given in Figs. 11 to 26 represent binary digital signals in hexadecimal notation; "0" to "F" in the uppermost row each correspond to the four bits on the LSB side of a 12-bit input codeword, and "00" to "FF" in the leftmost column each correspond to the eight bits on the MSB side of a 12-bit input codeword, each row and column intersection "XXXX" forming the resulting 16-bit codeword. For example, when a 12-bit dataword "15A" is input, a codeword "9539" is obtained from the intersection between the row of "15" and the column of "A" (see Fig. 12). For a 12-bit input codeword (the second codeword), the resulting codeword consists of 16 bits, of which the MSB corresponds to a Q signal ("1" for a high level and "0" for a low level, representing the end level of an NRZI-modulated codeword when the MSB of the premodulation codeword is "0"), the 15th bit represents the CDS information ("1" for +1 and "0" for -1), and the remaining bits from the 14th bit to the LSB correspond to the bits from the 14th bit to the LSB of the 15-bit codeword to be NRZI-modulated. For the m/n (12/15) data conversion, the codeword output is selected as 16 bits because the codeword MSB control is performed by comparing the CDS information of the codeword to be converted with the end level of the previous NRZI-modulated codeword on the basis of a DSV control signal of 50% duty cycle derived by further dividing the data conversion rate signal.

Fig. 27 is a diagram showing an example of a circuit configuration implementing the first embodiment. The reference numeral 3 designates a clock generator circuit which generates, from a channel clock for transmitting a data-converted code, a symbol clock of fCH/10 for transmitting a first codeword (r), a clock (fMW/2) of fCH/30 (a value obtained by multiplying 24, the least common multiple of r and m, by n/m (10/8)) for word-converting the first dataword to the second dataword, a clock (fMW) for parallel-transmitting a converted n-bit codeword, and a DSV control signal (I) for determining the variation frequency of DSV.

The numeral 4 is a shift register constructed from three stages of flip-flops (F-F) for transmitting 8-bit first datawords in parallel at the symbol clock (fsym); 5 is a latch circuit that latches at the clock (fMW/2) the 24-bit parallel signal output from the shift register 4; 6 is a selector for word-converting the first datawords of 3 bytes to two second datawords by using the clock (fMW/2) as a select switch; 7 is an encoder for data-converting each 12-bit dataword to a codeword selected from the tables shown in Figs. 11 to 26; and 8 is an MSB controller for outputting the MSB of the codeword in accordance with the Q and CDS information supplied from the encoder 7 and the DSV control signal (I) supplied from the clock generator circuit 3, the MSB controller 8 having four EXOR circuits, A to D, and a one-word decay for delaying the end level of the previous NRZI-modulated codeword by one encoding cycle by using the clock (fMW). Further, the numeral 9 designates a parallel/serial converter for loading the encoded 15-bit parallel signal at the clock (fMW) and for converting the parallel signal to a serial signal which is transmitted at the channel clock (fCH),

and the numeral 10 indicates an NRZI modulator for causing state inversion (high to low and low to high transitions) when signal "1" is input.

Fig. 28 is a timing diagram for explaining the operation of the circuit shown in Fig. 27. The reference signs (a) to (k), (m), (n), and (r) correspond to the respective points designated by the same signs appearing at the inputs/outputs of the respective circuit sections.

The operation of the circuit will now be described in detail. 8-bit first datawords (r) fed from an error-correcting circuit section are shifted at the symbol clock (fsym) into and along the shift register 4 and are output as a 3-byte or 24-bit parallel signal. The 24-bit parallel signal is latched by the latch circuit 5 at the clock (fMW/2) of three-symbol cycle. That is, three bytes of signals "08", "1A", and "93" are latched by the latch circuit 5 at the rising edge, between times 3 and 4, of the clock (fMW/2) shown in Fig. 28. Of the three bytes of parallel signals, the first byte (8 bits) "08" is input to DH11 - DH4 of the selector 6, and the four bits of "1" on the MSB side of the second byte are input to DH3 - DH0 of the selector 6. Further, the last byte (8 bits) "93" is input to DL11 - DL4 of the selector 6, and the four bits of "A" on the LSB side of the second byte are input to DH3 - DH0, respectively. As a result, between time 4 and the first half of time 5 in Fig. 28, the selector 6 outputs a 12-bit parallel signal "081". Between the second half of time 5 and time 6, the selector 6 outputs a 12-bit parallel signal "93A".

With the above operation, the three 8-bit first datawords "08", "1A", and "93" are word-converted to two 12-bit second datawords, "081" and "93", by dividing the second of the three first datawords into two and appending the respective halves to the LSBs of the first and third bytes of the first dataword. Likewise, the three bytes of the first dataword, "41", "DE", and "F2", latched by the latch circuit 5 at the rising edge, between times 6 and 7, of the clock (fMW/2) in Fig. 28, are word-converted by the selector 6 to two second datawords "41D" and "F2E".

Next, we will describe in detail the operation for converting the 12-bit second datawords to 15-bit codewords. For the convenience of explanation, it is assumed that, at time 4 in Fig. 28, the output Q' of the one-word delay in the MSB controller 8 is low, and that the DSV value for the codeword sequence up to the converted second dataword immediately preceding "081" is 0.

In this condition, when the second dataword "081" is input to the encoder 7 during the period from time 4 to the first half of time 5, the encoder 7 outputs a signal, 8BC9, in accordance with the conversion tables shown in Figs. 11 to 26, the signal having a total of 16 bits, i.e. a codeword formed from the LSB to the 14th bit and the CDS signal and Q signal, one bit each, associated with the codeword. To describe the contents of the signal, of the four bits "1000" corresponding to "8", the MSB represents the Q signal, "0" for a low level and "1" for a high level. Further, of "1000" corresponding to "8", the bit immediately preceding the MSB represents the CDS signal for the codeword, "0" indicating CDS = -1 and a low level and "1" indicating CDS = +1 and a high level. The remaining two bits of the "1000" corresponding to "8", plus the 12 bits "BC9", a total of 14 bits, constitute the data-converted codeword which has 14 bits of "00101111001001" from the 14th bit to the LSB.

Of the signals thus created, the Q signal and the CDS signal are input, along with the DSV control signal (i), to the MSB controller 8 which then determines and outputs the MSB of the codeword in accordance with the operation hereinafter described. The DSV control signal (i) is set at "1" (high level) if the DSV is to be dispersed in the positive direction and at "0" (low level) if the DSV is to be dispersed in the negative direction. In the present embodiment, the DSV control signal is set at a high level for the duration of times 4, 5, and 6 and at a low level for the duration of times 7, 8, and 9, so that the CDS is controlled to give +1 for encoding the second datawords "081" and "93A" and -1 for encoding the second datawords "41D" and "F2E".

The operation of the MSB controller 8 will now be described in detail. First, using the EXOR circuit A, it is checked whether the CDS value of the codeword currently output agrees with the direction in which the DSV is to be dispersed; if they agree, a 0 is output, and if they do not agree, a 1 is output, thereby making the CDS value of the codeword agree with the dispersing direction of the DSV. Note, however, that the above output condition is based on the assumption that encoding is performed with the start point of the codeword at a low level at the time of NRZI modulation. Also note that the MSB needs to be determined by referencing the Q' signal (a 0 for a low level and a 1 for a high level) indicating the end level of the previous NRZI-modulated codeword. The output of the EXOR circuit A and the Q' signal are both input to the EXOR circuit B, and when the Q' signal is "0" (indicating that the NRZI-modulated word level at the end of the previous codeword is low), the output level of the EXOR circuit A appears unchanged at the output of the EXOR circuit B. On the other hand, when the Q' signal is "1" (indicating that the NRZI-modulated word level at the end of the previous codeword is high), since the polarity of the CDS of the codeword is inverted after NRZI modulation, the output level of the EXOR circuit A appears inverted at the output of the EXOR circuit B. The output of the EXOR circuit B is supplied as the MSB of the codeword to the parallel/serial converter 9.

To describe the above operation as applied to the present embodiment, when the second dataword "081" is input to the encoder 7, the CDS signal output from the encoder 7 is "0", and the DSV control signal

(i) is at a high level ("1") that causes the DSV to disperse in the positive direction, as can be seen from Fig. 28, so that the EXOR circuit A outputs a high level signal ("1"). At this time, the Q' signal that indicates the end level of the previous NRZI-modulated codeword is at a low level ("0"), so that the EXOR circuit B outputs a 1 as the MSB of the codeword.

As a result, a 15-bit parallel signal "1001011101" is loaded into the parallel/serial converter 9 in the middle of time 5 when the clock (fMW) goes low. The loaded bits are then output serially at the channel clock (fCH) from the parallel/serial converter 9 to form a code sequence with the MSB at the top of the sequence. The code sequence output from the parallel/serial converter 9 is fed to the NRZI modulator 10 where the polarity of the signal is inverted each time a "1" is input, the resulting signal being shown in Fig. 28(k). Here, with +1 as a high level and -1 as a low level, the CDS can be calculated as +1, which indicates that the DSV of the code sequence is in the positive dispersing direction.

With the above operation, the 12-bit dataword is data-converted to the 15-bit codeword in accordance with the DSV control signal, but it is further necessary to check the end level of the NRZI-modulated codeword, as previously described. This is accomplished by the following operation.

The Q signal from the encoder 7 and the MSB signal from the EXOR circuit B are input to the EXOR circuit C in the MSB controller 8. When the MSB is "0", the Q signal appears unchanged at the output of the EXOR circuit C. On the other hand, when the MSB is "1", the number of inversions that occur in the NRZI modulation increases by one as the number of 1s in the codeword increases by one, and therefore, the Q signal is inverted for output. During the NRZI modulation, the polarity is inverted between positive and negative in accordance with the level of the connected signal. Therefore, the output of the EXOR circuit C is input to the EXOR circuit D along with the Q' signal indicating the word end level of the previous NRZI-modulated codeword, and when the Q' signal is "0" (indicating the word end level after NRZI modulation is low), the output signal of the EXOR circuit C appears unchanged at the output of the EXOR circuit D. On the other hand, when the Q' signal is "1" (indicating the word end level after NRZI modulation is high), the output of the EXOR circuit C is inverted through the EXOR circuit D. The output of the EXOR circuit D is supplied to the one-word delay as a signal indicating the end level of the NRZI-modulated codeword for the immediately following data conversion.

To describe the above operation as applied to the present embodiment, when the second dataword "081" is input to the encoder 7, the Q signal output from the encoder 7 is "1", and the MSB output from the EXOR circuit B is also "1", as can be seen from Fig. 28, so that the output of the EXOR circuit D is at a low level ("0"). At this time, the signal Q' that indicates the end level of the previous NRZI-modulated codeword is at a low level ("0"), and therefore, the EXOR circuit D outputs a signal "0" indicating that the end level of the NRZI-modulated codeword is low, the signal "0" being input at the clock (fMW) to the one-word delay through which the signal is delayed by one encoding cycle. By repeating the above operation for every m/n data conversion with one word delay at each time, the end level of each codeword can be checked correctly for continuous sequences of codewords.

As described above, the data that has been word-converted by the selector 6 from 8-bit first datawords to 12 bit second datawords is converted by the encoder 7 to a 16-bit codeword, which is further converted by the MSB controller 8 to a 15-bit codeword, capable of determining the dispersing direction of the DSV as desired by the DSV control signal (i), by converting the two bits on the MSB side of the 16-bit codeword to a one-bit signal that determines the polarity of the CDS. Likewise, subsequent second datawords "93A", "41D", and "F2E" are respectively input to the encoder 7 and converted to the signal shown in Fig. 28(j), with their CDSs being controlled in accordance with the DSV control signal (i). As a result, the DSV value at the codeword end obtained at the output of the NRZI modulator 10 has a variation width p - p2 over four data conversion cycles as shown in Fig. 28(k), the resulting signal thus being made to synchronize with the DSV control signal.

The power spectrum of the digital signal is dependent on the state transition probability, and by keeping the DSV variation cycle at a constant value, the state transition occurring at the DSV variation cycle becomes high, thus making it possible to obtain a spectrum having high power at frequencies corresponding to the DSV variation cycle. In the present embodiment, the cycle of the DSV control signal is selected to be equal to four m/n data conversion cycles. However, if the signal cycle is set equal to about 10 data conversion cycles, it will be possible to obtain a relatively low frequency signal corresponding to the DSV variation cycle synchronized with the digital data, and such a low frequency signal can be used as a tracking pilot signal that will become necessary when the track width is reduced. Fig. 29 is a diagram illustrating the power spectrum obtained when first datawords constructed from 8-bit M-sequence random signals expressed as $X^{23} + X^5 + 1$ are input in a circuit constructed in accordance with the first embodiment but with the cycle of the DSV control signal set equal to ten m/n data conversion cycles. As can be seen from Fig. 29, the resulting spectrum has no DC content (DC-free) and, at the same time, exhibits high power only at frequencies corresponding to the cycle of the DSV control signal.

We will now describe a digital magnetic record-

ing/reproducing apparatus that can be constructed into a system optimized for the above-described data conversion method.

Digital magnetic recording/reproducing apparatus such as DAT, digital VTR, etc. have the characteristic of being insusceptible to system variation in the sense that degradation in the signal-to-noise ratio does not lead to degradation in the audio and video reproduction performance as long as 1s and 0s can be distinguished. On the other hand, there is some danger with such digital apparatus that only a single bit error in a large volume of information may entirely change the contents of the information. Therefore, in digital magnetic recording/reproducing apparatus, it is essential to employ error-correcting codes for correction of errors caused on the transmission channel. Usually, error-correcting codewords are recorded in error-correcting code blocks separated from one another by a synchronizing signal as shown in Fig. 30. In Fig. 30, the numeral 21 is the synchronizing signal for separating one error-correcting code block from another, 22 is an ID signal for the block identified by the track number or the synchronizing signal, 23 is a parity-check codeword for checking whether the ID signal is correctly reproduced, 24 is an audio/video sector, and 25 is an error-correcting code. Rotary head type digital magnetic recording/reproducing apparatus usually have about 100 such blocks per track, each block being separated by the synchronizing signal.

The following description deals with a method of setting the amount of information for each block.

The synchronizing signal 21 serves not only as a signal for separating each error-correcting code block but also as a signal for executing word synchronization for decoding the codeword, encoded and recorded as previously described, into the original dataword. The synchronizing signal thus has a very important role, and therefore, a unique signal that does not usually appear in the recorded signal sequences is often used as the synchronizing signal. This unique signal can only be obtained by reconverting the data-converted codeword. According to the data conversion method of the first embodiment in which 8-bit first datawords are first converted to 12-bit second datawords and then converted to 15-bit codewords, the synchronizing signal length corresponds to 1.5 bytes in the original first datawords. Therefore, if the synchronizing signal sector is constructed from one-byte synchronizing signal data plus 0.5 byte obtained by dividing the first dataword, these components would become separated at the time of decoding, so that the 0.5 byte in the synchronizing signal sector would cause a fixed error and therefore, the one byte data immediately following the synchronizing signal data would also cause a fixed error. This problem may be solved by inserting a dummy dataword of one byte immediately following the first dataword (which may be formed from a fixed pattern) used for the synchronizing signal.

However, it is not advantageous in terms of space utilization to add a dummy dataword in a limited package. Therefore, in the recording/reproducing apparatus employing the data conversion method of the first embodiment, the first dataword used for the synchronizing signal is constructed from a fixed pattern of one byte, and the immediately following first dataword is constructed from a fixed pattern of four bits on the MSB side and data (e.g., a cue signal, track address, etc.) of four or less bits on the LSB side. Ordinary 8-bit datawords are mapped starting with the first dataword of the third byte. The pattern of the synchronizing signal sector may be set in any pattern suitable for the reconversion performed after ordinary data conversion.

We will now describe a method of setting the number of first datawords for each block separated by the synchronizing signal. According to the data conversion method of the first embodiment, r-bit first datawords are first word-converted to m-bit second datawords and then data-converted to n-bit codewords. This requires word synchronization for every x bits, where x is the least common multiple of r and m. For example, in the present embodiment, $r = 8$ and $m = 12$, and hence the least common multiple is 24 bits, so that the first codewords are word-synchronized for every three bytes. Since word synchronization is performed for every three bytes in each block, as described above, if the number of first datawords in the block is not an integral multiple of 3, the first dataword remaining after dividing the number by 3 will cause a fixed error. Therefore, in the recording/reproducing apparatus employing the data conversion method of the first embodiment, the number of first datawords per block is selected to be equal to an integral multiple of x/r.

The following describes a method of converting the reproduced 15-bit codeword back to the original 12-bit second dataword in the recording/reproducing apparatus employing the above-described data conversion method.

Fig. 32 is a diagram illustrating an example of a circuit configuration for decoding the reproduced 15-bit code-word into the original 12-bit second dataword (m), employed in the recording/reproducing apparatus using the data conversion method of the first embodiment. In Fig. 32, the reference numeral 11 is an NRZI demodulator for NRZI-demodulating the reproduction signal transmitted by a reproduction channel clock; 12 is a serial/parallel converter for converting the NRZI-demodulated serial signal, fed from the NRZI demodulator 11, to a 15-bit parallel signal by using a reproduction word clock which is word-synchronized by a synchronizing signal appended to the top of each block; 13 is a first decoder for accepting at its input the 10 bits n1 on the MSB side of the

15-bit codeword (n) output from the serial/parallel converter 12 and for decoding the n1 into a dataword that forms the eight bits on the MSB side of the second dataword; and 14 is a second decoder for accepting at its input the five bits n2 on the LSB side of the 15-bit codeword (n) output from the serial/parallel converter 12 and for decoding the n2 into a dataword that forms the four bits on the LSB side of the second dataword. The numeral 15 designates a third decoder for decoding the 15-bit codeword, output from the serial/parallel converter 12, into 12-bit decoded data. The third decoder 15 is constructed to perform one-to-one decoding when the five bits on the LSB side is of a prescribed type.

Furthermore, the reference numeral 16 indicates an LSB discriminating circuit which accepts at its input the five bits on the LSB side of the 15-bit codeword output from the serial/parallel converter 12, and which discriminates the type of the codeword and outputs a control signal (o) designating the classification type; and 17 refers to a selector which selects either the 12-bit dataword having decoded data from the first decoder 13 and the second decoder 14 or the 12-bit dataword from the third decoder 15 by using the control signal supplied from the LSB discriminating circuit 17 as a select SW, and which generates the second dataword (m) after decoding.

The operation of this embodiment will now be described. The reproduction signal is NRZI-demodulated by the NRZI demodulator 11 and fed to the serial/parallel converter 12 through which the demodulated serial signal is converted to a 15-bit codeword (n). Of the 15 bits in the codeword (n), the 10 bits n1 on the MSB side are entered to the first demodulator 13, and the five bits n2 on the LSB side are fed to the second demodulator 14 as well as to the LSB discriminating circuit 16. On the other hand, all the 15 bits of the codeword (n) are loaded directly into the third demodulator 15.

We will now describe in detail the operation of decoders for decoding the 15-bit codeword back into the 12-bit second dataword. From Figs. 8 to 10, the five-bit codeword n2 on the LSB side of the 15-bit codeword can be classified in relation to the demodulated 4-bit dataword m2, as shown in Fig. 33. The codewords classified as the first LSB code group in Fig. 33 correspond to the LSB codewords n2 in the first and second coding groups in Figs. 8 and 9 as well as in the first n1 group for m1 = "BB" to "E7" in the third coding group in Fig. 10, and each n1 in the n1 group is related to one decoding data m1 within the limits of the first LSB code group. Further, the codewords classified as the second LSB code group correspond to the LSB codewords classified as the second n1 group in the third coding group as well as the fourth n1 group for m1 = "EE" to "FF in the same coding group. The codewords classified as the third LSB code group correspond to the LSB codewords classified as the third n1 group while the codewords classified as the fourth LSB code group correspond to the LSB codewords in the n1 group for m1 = "E8" to "FF". Note, however, that the n1 group in the second to the fourth LSB code groups overlaps with the n1 group in the first LSB code group, and that, in some cases, a plurality of m2 are mapped to one LSB codeword n2.

Now, the first decoder 13 decodes the 10 bits on the MSB side into an eight-bit dataword. In this case, the top bit in the 10-bit codeword is a control bit for controlling the DSV during demodulation and may therefore be disregarded at the time of decoding. Thus, the remaining nine bits are decoded. The decoding is performed on the codewords in the first and second coding groups in Figs. 8 and 9 as well as in the first n1 group for m1 = "BB" to "E7" in the third coding group in Fig. 10, and the decoded 8-bit dataword is applied to V11 - V4 on the selector 17 as data representing the eight bits on the MSB side of the second dataword. On the other hand, the second decoder 14 decodes the five bits on the LSB side into a four-bit dataword. In this case, the decoding is performed on the codeword n2 in the first LSB code group. The decoded 4-bit dataword is applied to V3 - V0 on the selector 17 as data representing the four bits on the LSB side of the second dataword. The third decoder 15 decodes the input 15-bit codeword into a 12-bit dataword. In this case also, the top bit on the MSB side is excluded, as in the case of the first decoder 13, and the remaining 14 bits are decoded. The decoding is performed only when the five-bit LSB codeword falls in one of the second to the fourth LSB code groups, and the decoded 12-bit dataword is applied to W11 - W0 on the selector 17.

The selector 17 is switched to select either the dataword supplied from the first decoder 13 and second decoder 14 or the dataword supplied from the third decoder 15, and outputs the selected dataword as the decoded second dataword; the switching of the selector 17 is controlled by a control signal supplied from the LSB discriminating circuit 16. Of the 15 bits in the codeword, the five bits n2 on the LSB side are input to the LSB discriminating circuit 16 to discriminate the type of the LSB codeword. For example, if the LSB codeword n2 is a codeword discriminated as belonging to one of the second to the fourth LSB code groups, the LSB discriminating circuit 16 outputs a control signal (o) indicating the discriminated type and applies it to the select SW on the selector 17. When no control signal (o) is received, the selector 17 selects the eight-bit MSB dataword V11 - V4 supplied from the first decoder 13 and the four-bit LSB dataword V3 - V0 supplied from the second decoder 14 and outputs the resulting 12-bit dataword V. On the other hand, when the control signal (o) is received, the selector 17 is switched to select the 12-bit dataword W decoded by the third decoder 15.

Thus, the selector 17 outputs the 12-bit dataword m obtained by reconverting the codeword that was encoded in accordance with the tables shown in Figs. 8 to 10. As described, the 15-bit codeword is decoded on a one-to-one basis to the 12-bit dataword only when the five-bit LSB codeword n2 is discriminated as belonging to one of the second to the fourth LSB code groups in Fig. 33; otherwise, the 15-bit codeword is decoded by dividing it into 10 bits on the MSB side and five bits on the LSB side. This construction serves to reduce the possibility of the error propagation that may occur between decoded first datawords due to a single bit detection error in the 15-bit codeword.

In the above decoding method, the discrimination of the five-bit LSB codeword is determined by which of the two major groups, the first LSB code group or the second to fourth LSB code group, the LSB codeword belongs to. However, in an alternative method, the types of codeword may be classified into three major groups, for example, the first LSB code group, the second LSB code group, and the third/fourth LSB code group, and four decoders, i.e. the first to the fourth decoders, may be provided, the outputs of these decoders being selected accordingly by using a control signal from the LSB discriminating circuit. Such configuration may somewhat increase the circuit complexity compared to that of the above embodiment, but will serve to further reduce the possibility of error propagation between decoded first datawords.

Thus, according to the first embodiment, eight-bit first datawords are first word-converted to 12-bit second datawords, and then, the 12-bit second datawords are converted to 15-bit codewords, each having bits of CDS = +1 or -1, by executing word-synchronization for every two second datawords, which is the least common multiple of the first and second datawords. In the conversion process, the first byte of the first dataword is mapped to the eight bits on the MSB side of the first of the two second datawords, and the four bits on the MSB side of the second byte of the first dataword are mapped to the four bits on the LSB side of the first of the two second datawords. For the second of the two second dataword, the third byte of the first dataword is mapped to the eight bits on the MSB side, while the four bits on the LSB side of the second byte of the first dataword are mapped to the four bits on the LSB side of the second of the two second datawords, thus accomplishing the 8/12 word-conversion. Thereafter, each 12-bit dataword is converted to a 15-bit codeword (12/15 data conversion). This encoding method permits the 8/10 encoding of non-divided first datawords and the 4/5 encoding of divided first datawords, which serves to reduce the possibility of the error propagation that may occur, due to a single bit error in the codeword, between first datawords during reverse conversion at the time of decoding. Furthermore, when this data conversion method is applied to a recording/reproducing apparatus, it is possible to construct a system capable of efficient recording of data without requiring redundant bits, the system being constructed such that the number of first datawords for each block separated by a synchronizing signal is set at a multiple of r/x and that the first dataword as the synchronizing signal at the beginning of the block is formed from a fixed pattern and the immediately following first dataword is formed From a fixed pattern of four bits on the MSB side and data of four or less bits (e.g., cue signal, track address, etc.) on the LSB side.

On the other hand, when decoding the 15-bit codeword into the 12-bit second dataword, the 15-bit codeword is divided into 10 bits on the MSB side and five bits on the LSB side, and the 10 bits are decoded into eight bits by the first decoder and the five bits are decoded into four bits by the second decoder, while the 15 bits are decoded into 12 bits by the third decoder. The discriminating circuit discriminates the type of the five bits on the LSB side of the 15-bit codeword and outputs a control signal indicating the discriminated type, on the basis of which the decoded data from the decoders are selected to reconstruct the second dataword. Thus, the codeword is decoded by reverse conversion of 10/8 and 5/4, except when the LSB codeword falls under specific conditions. This has the effect of reducing the possibility of the error propagation that may occur between decoded first datawords due to a detection error in the codeword.

(Embodiment 2)

A second embodiment of the invention will now be described below. Suppose a code of dataword length = 12 and codeword length = 14 with one bit added to form a code with Tmax/Tmin = 5. Here, let d = 0 and k = 4. The NRZI(F) rule is used to construct the code. To satisfy k = 4 in each codeword, the number of successive 0s in the codeword is limited to 4, and since one bit is inserted between codewords, the number of successive 0s is limited to 2 on the MSB side and 1 on the LSB side.

To form a DC-free code, 4096 pairs of codewords, each pair having codewords of different CDS polarities, should be provided. There are 2481 codewords with CDS = 0, 2169 codewords with CDS = +2, and 1888 codewords with CDS = -2, which satisfy the above conditions. Hence, 2481 codewords with CDS = 0 and 1615 pairs of codewords with CDS = ± 2, which differ only in MSB, are used to suppress the dispersion of DSV to achieve DC-free modulation. Code conversion tables thus constructed are shown in Figs. 34 to 49. The data given in Figs. 34 to 49 represent binary digital signals in hexadecimal notation. For every 12-bit input data (dataword), there are out-

put a total of 16 bits, i.e. a 14-bit codeword, one-bit data (hereinafter represented by Q) indicating the number of inversions performed on the NRZI-modulated codeword, and the CDS (a zero or nonzero bit) of the codeword.

Fig. 50 is a diagram illustrating an example of a circuit configuration implementing the second embodiment. In Fig. 50, the reference numeral 33 is an encoder for converting 12-bit digital data (dataword) to 16-bit digital data shown in Figs. 34 to 49; 34 and 36 are NOT gates; 35, 37, 38, and 39 are EXOR gates; 40, 42, and 48 are flip-flops; 41 and 46 are selectors; 43 is a parallel/serial converter for converting 14-bit or 15-bit parallel data to a serial data sequence; 44 is a counter; 45 is a four-input NAND gate; and 47 is an NRZI modulator for processing the codeword, converted to serial data, so that the signal polarity is inverted each time a 1 is input.

Fig. 51 shows a code select table used to determine a code to be selected in accordance with the current and the previous DSV control signal values, the CDS value of the codeword just selected, and the previous Q' signal.

Fig. 52 is a diagram illustrating code conversion and DSV value variation according to the second embodiment. In Fig. 52, (a) is a pilot signal (write at "1"), (b) is a DSV control signal (positive direction at "1"), (c) is input data (12 bits), (d) is a code select signal Q', (e) is a selected codeword, (f) is a signal waveform to be recorded, and (g) is a DSV value at the end of each codeword.

Fig. 53 is a diagram illustrating the recording format of a magnetic recording/reproducing apparatus according to the second embodiment. In Fig. 53, subcode signals, etc. are recorded in the subdata areas (SUB1, SUB2), and video and audio signals are recorded in the main data area (MAIN). Pilot signals are recorded in the subdata areas (SUB1, SUB2).

The circuit operation of the second embodiment will now be described below with reference to Fig. 50.

First, when the pilot area signal output from the flip-flop 48 is "0", i.e. when data other than that for the subdata area is to be encoded for recording, 12-bit data is input to the encoder 33 where the 12-bit data is converted to a 14-bit codeword (parallel) by using the code select signal Q' supplied from the flip-flop 42. The resulting 14-bit codeword is supplied to the parallel/serial converter 43. The encoder 33 also outputs a Q signal which is supplied to the selector 41. On the other hand, the selector 46 selects "10" by the input pilot area signal "0", which sets the load value of the counter 14 to "0010", and the counter 14 outputs a load CLK of one CLK width to the parallel/serial converter 43 for every 14 CH-CLKs. The parallel/serial converter 43 converts the input 14-bit parallel codeword to serial data which is fed to the NRZI modulator 47. At this time, the output of the NOT gate 34, i.e. the LSB, is input to the parallel/serial converter 43, but since a load CLK is input for every 14 CH-CLKs, the LSB is not output from the parallel/serial converter 43. The serial codeword input to the NRZI modulator 47 is NRZI-modulated for output. The Q signal output from the encoder 33 is input to the selector 41 which selects the Q signal by the pilot area signal and supplies it to the flip-flop 42.

On the other hand, when the pilot area signal output from the flip-flop 48 is "1", i.e. when data for the subdata area is to be encoded for recording, 12-bit data is input to the encoder 33 which converts the 12-bit data to a 14-bit codeword (parallel) by using the code select signal Q' supplied from the flip-flop 42. The resulting 14-bit codeword is supplied to the parallel/serial converter 43. The encoder 33 also supplies a Q signal to the selector 41 and the NOT gate 34, and a CDS signal to the EXOR gate 35. The selector 46 selects "01" by the input pilot area signal "1", which sets the load value of the counter 14 to "0001", and the counter 14 supplies a load CLK of one CLK width to the parallel/serial converter 43 for every 15 CH-CLKs. The parallel/serial converter 43 converts the input 14-bit parallel codeword and LSB to serial data which is supplied to the NRZI modulator 47. The serial codeword input to the NRZI modulator 47 is NRZI-modulated for output. The DSV control signal is input to the flip-flop 40 and the EXOR gate 39, the output of the flip-flop 40 being coupled to the other input of the EXOR gate 39. The output of the EXOR gate 39, i.e. the exclusive OR sum of the current DSV control signal and the previous DSV control signal, is supplied to one input of tie EXOR gate 38. The EXOR gate 35 EXORs the CDS signal output from the encoder 33 with the Q' signal. The output of the EXOR gate 35 is inverted through the NOT gate 36 and applied to one input of the EXOR gate 37. The EXOR gate 37 EXORs the output of the NOT gate 36 with the Q' signal and supplies the result to the other input of the EXOR gate 38. The EXOR gate 38 EXORs the outputs of the EXOR gates 37 and 39 and supplies the result to the other input of the selector 41. In this manner, the signal selected in accordance with the codeword select table is output as a Q" signal. The Q" signal is selected by the pilot area signal and is fed to the flip-flop 42 to form a code select signal Q' for the next coding.

Suppose, for example, that the pilot area signal is "0", the input data is "3FF", the previous polarity is "1", and the Q' signal is "0". In this case, the 14-bit codeword output from the encoder 33 is "11001000010111"; the CDS is -2 and the DSV is also -2. As a result, the Q signal "0" is output. Next, when data "200" is input, since the Q' signal, i.e. the previous Q signal, is "0", the selected codeword is "01110011011010"; the CDS is +2 and the DSV is 0. Next, when the pilot area signal and the DSV control signal both go to a "1" and data "E11" is input, since the Q' signal is "1", the output codeword is

"11010111010101", and a Q signal of "0" and a CDS signal of "0" are output; CDS and DSV are both 0. When data "715" is input, since the Q' signal is "1", the selected codeword is "00101111101001" and the LSB is "0"; CDS and DSV are both +1. Next, when data "BFC" is input, since the Q' signal is "1", the selected codeword is "10100111101110" and the LSB is "1"; CDS is +1 and DSV is +2. The above operation is repeated for the subdata areas where the pilot area signal is "1", thereby achieving a modulation method in which the DSV varies at the cycle of the DSV control signal.

Using the above-described modulation method, a tracking servo pilot signal is recorded at two places within one track. Therefore, in the subdata areas (SUB1, SUB2), one LSB bit is added to the 14-bit codeword to form a 15-bit codeword, as described previously, and modulation is performed on the codeword including the pilot signal, while for other areas, the 14-bit codeword is directly modulated.

According to the format shown in Fig. 53, two subdata areas are provided within one track, and the pilot signals are recorded in these areas. Alternatively, three or more pilot signal recording areas may be provided within one track in order to enhance the tracking accuracy with a narrower track. It will also be appreciated that the pilot signal may be recorded in any portion within the subdata areas.

As described, according to the second embodiment, 12-bit datawords are each converted to a 14-bit codeword which, after NRZI modulation, has a succession of the same level, more than one bit long and five bits at maximum, and provides CDS = 0, +2 or -2, the CDS value being controlled to suppress the dispersion of DSV, thus accomplishing a DC-free modulation method. Furthermore, in areas where pilot signals are recorded, one bit is added to the 14-bit codeword to form codewords of CDS = ± 1, and the modulation is performed so that the DSV varies in synchronism with the DSV control signal to produce a tracking control pilot signal. This eliminates the need for ATF areas, the areas where only tracking control signals are recorded. Moreover, since one bit is added to the codeword and the pilot signal is recorded in a restricted area, it is not necessary to substantially raise the recording rate, and therefore, high density recording is achieved. Furthermore, since the modulation method is basically the same for both the pilot signal areas and other areas, the configuration does not involve any appreciable increase in the circuit complexity.

As this invention may be embodied in several forms without departing from the spirit of essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within metes and bounds of the claims, or equivalence of such metes and bounds thereof are therefore intended to be embraced by the claims.

Claims

1. A data conversion method for word-converting an r-bit first dataword to an m-bit second dataword (r < m) and converting the word-converted m-bit second dataword to an n-bit codeword (m < n), comprising the steps of:

   dividing a sequence of first datawords into groups of x bits where x is the least common multiple of r and m;

   dividing into x/m an arbitrary first dataword selected from a group which consists of x/r first datawords; and

   forming the m-bit second dataword by appending r/(x/m)-bit data, obtained by dividing the first dataword into x/m, to the LSB or MSB side of one or other of the non-divided first datawords.

2. A recording/reproducing apparatus employing the data conversion method of claim 1, comprising:

   means for formatting blocks so that each block separated by a synchronizing signal contains the first datawords of the number equal to an integral multiple of x/r.

3. A recording/reproducing apparatus employing the data conversion method of claim 1, comprising:

   means for mapping r bits and r/(x/m) bits to a second dataword corresponding to a synchronizing signal; and

   means for mapping the remaining bits of the divided first dataword to a signal, other than the synchronizing signal, that can complete as data with the remaining bits alone.

4. A recording/reproducing apparatus employing the data conversion method of claim 1, comprising:

   first decoding means for decoding n1 bits in the reproduced n-bit codeword into r bits, the reproduced n-bit codeword being divided into n1 bits and n2 bits for reverse conversion into the m-bit second dataword;

   second decoding means for decoding the n2 bits into r/(x/m) bits;

   third decoding means for decoding the n bits into the m bits;

   identifying means for identifying the type of bits at prescribed positions in the n-bit codeword and for outputting an identification signal designating the identified type; and

means for selecting decoded data from the first, second, or third decoding means on the basis of the identification signal supplied from the identifying means and for outputting the decoded second dataword.

5. A data converting apparatus for word-converting an r-bit first dataword to an m-bit second dataword (r < m) and converting the word-converted m-bit second dataword to an n-bit codeword (m < n), comprising:

means for dividing a sequence of first datawords into groups of x bits where x is the least common multiple of r and m;

means for dividing into x/m an arbitrary first dataword selected from a group which consists of x/r first datawords; and

means for forming the m-bit dataword by appending r/(x/m)-bit data, obtained by dividing the first dataword into x/m, to the LSB or MSB side of one or other of the non-divided first datawords.

6. A data conversion method for converting an m-bit dataword to a codeword consisting of a greater number of bits than m, comprising the steps of:

a first data conversion process wherein the m-bit dataword is converted to an n-bit codeword having a finite digital sum variation (DSV); and

a second data conversion process wherein the DSV is controlled at a desired value by appending one bit to the n-bit codeword obtained by the first data conversion process.

7. A data conversion method for dividing digital data first into 12-bit datawords and then converting the 12-bit datawords to 14-bit codewords,

wherein the number of successive 0s between a 1 and a 1 in each of the codewords is limited to 4 within the codeword and to 3 between codewords, and codewords having a codeword digital sum (CDS) of 0 are directly related to the 12-bit data, while for codewords having a CDS of +2 or -2, two codewords that differ only in MSB are paired and related to the 12-bit data, the two codewords being switched selectively by using polarity signals of the respective codewords.

8. A data conversion method for dividing digital data first into 12-bit datawords and then converting the 12-bit datawords to 15-bit codewords,

wherein one bit is appended to a 14-bit codeword converted in accordance with the data conversion method of claim 7, to form a pair of codewords, one having a CDS of +1 and the other having a CDS of -1, with the number of successive 0s between a 1 and a 1 in the code sequence being limited to 4, and one or other of the pair of codewords is selected in accordance with a DSV control signal with the DSV being made to vary in synchronism with the DSV control signal.

9. A magnetic recording/reproducing apparatus for recording multiple kinds of data in partitioned areas, wherein

when converting digital data to codewords for recording, the data conversion method of claim 8 is used for recording one or more areas within one track and the data conversion method of claim 7 is used for recording the other areas in the same track.

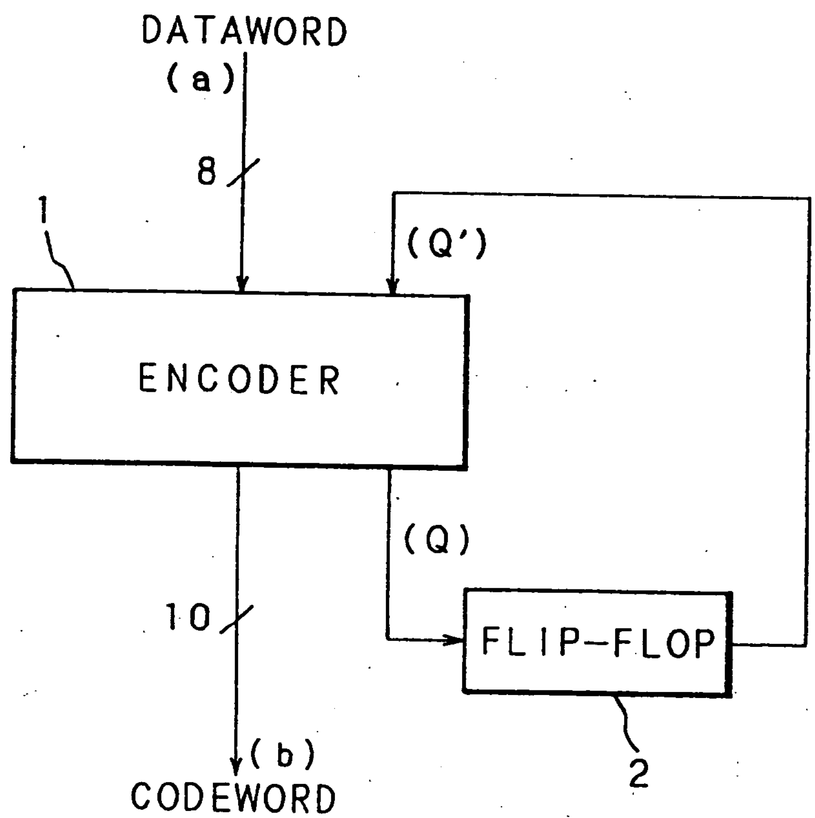
10. A data converting apparatus for converting an m-bit dataword to a codeword consisting of a greater number of bits than m, comprising:

means for converting the m-bit data to an n-bit codeword having a finite digital sum variation (DSV) as a first data conversion process; and

means for controlling the DSV at a desired value by appending one bit to the n-bit codeword obtained by the first data conversion process as a second data conversion process.

11. A data conversion method for word-converting first datawords, the method comprising, for each group of n first datawords, dividing x of the datawords by (n-x) and adding each divided part to a respective one of the other datawords in the group to form respective second datawords, and converting the second datawords to codewords of greater length.

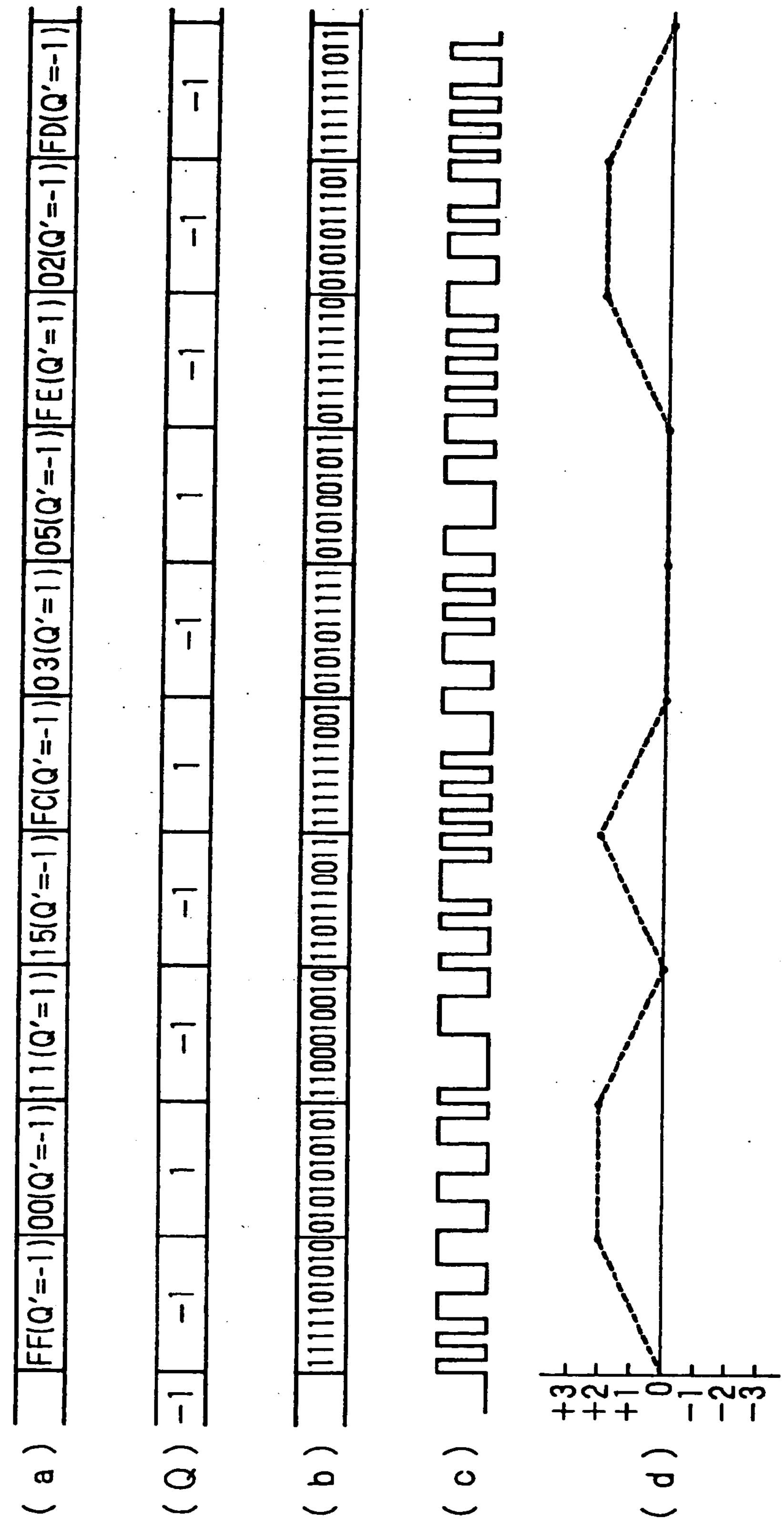
Fig. 1
Prior Art



F i g. 2
P r i o r A r t

		Q'=−1			Q'=1		
	DATAWORD (MSB−LSB)	CODEWORD (MSB−LSB)	DC	Q	CODEWORD (MSB−LSB)	DC	Q
00	00000000	0101010101	0	1	0101010101	0	−1
01	00000001	0101010111	0	−1	0101010111	0	1
02	00000010	0101011101	0	−1	0101011101	0	1
03	00000011	0101011111	0	1	0101011111	0	−1
04	00000100	0101001001	0	−1	0101001001	0	1
05	00000101	0101001011	0	1	0101001011	0	−1
06	00000110	0101001110	0	1	0101001110	0	−1
07	00000111	0101011010	0	1	0101011010	0	−1
08	00001000	0101110101	0	−1	0101110101	0	1
09	00001001	0101110111	0	1	0101110111	0	−1
0A	00001010	0101111101	0	1	0101111101	0	−1
0B	00001011	0101111111	0	−1	0101111111	0	1
0C	00001100	0101101001	0	1	0101101001	0	−1
0D	00001101	0101101011	0	−1	0101101011	0	1
0E	00001110	0101101110	0	−1	0101101110	0	1
0F	00001111	0101111010	0	−1	0101111010	0	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
F0	11110000	1101010101	0	−1	1101010101	0	1
F1	11110001	1101010111	0	1	1101010111	0	−1
F2	11110010	1101011101	0	1	1101011101	0	−1
F3	11110011	1101011111	0	−1	1101011111	0	1
F4	11110100	1101001001	0	1	1101001001	0	−1
F5	11110101	1101001011	0	−1	1101001011	0	1
F6	11110110	1101001110	0	−1	1101001110	0	1
F7	11110111	1101011010	0	−1	1101011010	0	1
F8	11111000	1111100101	2	−1	0111100101	−2	−1
F9	11111001	1111100111	2	1	0111100111	−2	1
FA	11111010	1111101101	2	1	0111101101	−2	1
FB	11111011	1111101111	2	−1	0111101111	−2	−1
FC	11111100	1111111001	2	1	0111111001	−2	1
FD	11111101	1111111011	2	−1	0111111011	−2	−1
FE	11111110	1111111110	2	−1	0111111110	−2	−1
FF	11111111	1111101010	2	−1	0111101010	−2	−1

Fig. 3
Prior Art



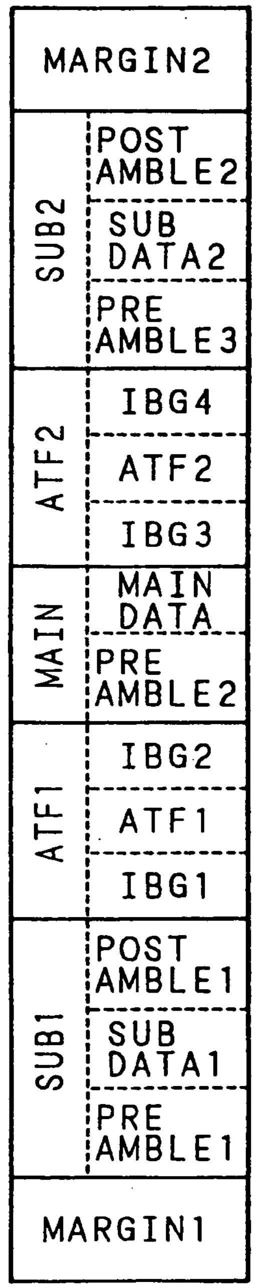


Fig. 4
Prior Art

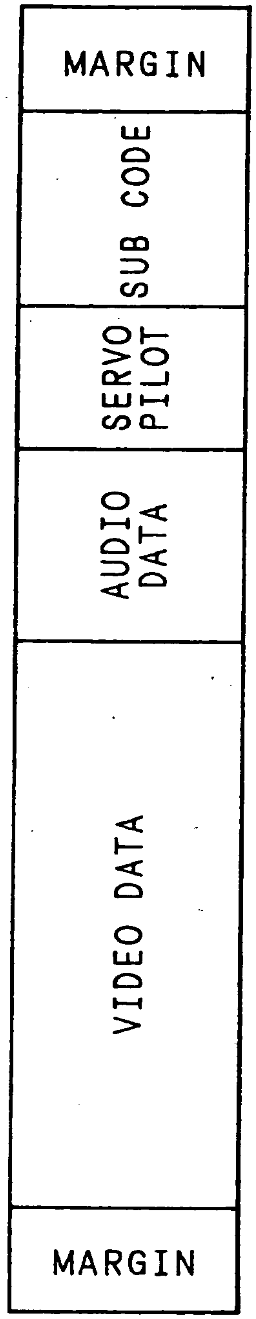


Fig. 5
Prior Art

Fig. 6

CDS	−1	+1	−3	+3	−5	+5
NUMBER OF CODEWORDS	2481	2169	1888	1231	909	410

F i g. 7

CONDITION OF n1	A CDS=0			B CDS=+2			C CDS=−2		D CDS=+4		E CDS=−4	
	A1	A2	A3	B1	B2	B3	C1	C2	D1	D2	E1	
NUMBER OF n1 CODEWORDS	102	14	4	51	17	3	116	4	18	2	68	
n2 CODEWORD MATCHING WITH n1	02 05 07 09 0A 0B 0D 0E 0F 12 15 17 19 1A 1B 1D 1E 1F	05 07 09 0A 0B 0D 0E 0F 12 15 17 19 1A 1B 1D 1E 1F	09 0A 0B 0D 0E 0F 12 15 17 19 1A 1B 1D 1E 1F	02 05 07 0A 0D 0F 19 1B 1E 01 03 06	02 05 07 0A 0D 0F 19 1B 1E 03 06	05 07 0A 0D 0F 19 1B 1E 06	09 0B 0E 12 15 17 1A 1D 1F 11 13 16	12 15 17 1A 1D 1F 11 13 16	01 03 06	03 06	11 13 16	

NOTE : SUBDIVISIONS OF A TO E GROUPS ARE EXECUTED FOR EACH n1 GROUP IN ACCORDANCE WITH "0" RUN-LENGTH AT LSB SIDE OF n1.

Fig. 8

	m1 DATAWORD	n1 GROUP	n2 CODEWORD m2	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	00 ~ 73	A GROUP (A1,A2)		07	09	0A	0B	0D	0E	0F	12	15	17	19	1A	1B	1D	1E	1F

Fig. 9

	m_1 DATAWORD	n_1 GROUP	m_2	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2	74~BA	1st n_1 GROUP C1			09		0B		0E		12	15	17		1A		1D	1E	
		2nd n_1 GROUP B1		07		0A		0D		0F				19		1B			1F

The n_2 CODEWORD heading spans the columns m_2 and 0 to F.

Fig. 10

	m_1 DATAWORD	n_1 GROUP	n_2 CODEWORD															
			m_2 0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
3	BB ~ E7	1st n_1 GROUP C1		09		0B		0E		12	15	17		1A		1D	1E	
		2nd n_1 GROUP B1	01		03		05		06									
		3rd n_1 GROUP E1											11		13			16
	E8 ~ ED	1st n_1 GROUP C1		11		13		16		11	13	16		11		13	16	
		2nd n_1 GROUP B1	01		03		05		06									
		3rd n_1 GROUP E1											11		13			16
	EE ~ FF	1st n_1 GROUP C1		11		13		16		11	13	16		11		13	16	
		2nd n_1 GROUP D1	01		03				06									
		3rd n_1 GROUP E1, C2											11		13			16
		4th n_1 GROUP B2, B3					05											

Fig. 11

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00	8847	4849	084A	C84B	884D	C84E	084F	4852	C855	4857	8859	C85A	085D	485D	085E	C85F
01	48A7	88A9	C8AA	08AB	48AD	08AE	C8AF	88B2	08B5	88B7	48B9	08BA	C8BD	88BD	C8BE	08BF
02	88E7	48E9	08EA	C8EB	88ED	C8EE	08EF	48F2	C8F5	48F7	88F9	C8FA	08FD	48FD	08FE	C8FF
03	4947	8949	C94A	094B	494D	094E	C94F	8952	0955	8957	4959	095A	C95D	895D	C95E	095F
04	89A7	49A9	09AA	C9AB	89AD	C9AE	09AF	49B2	C9B5	49B7	89B9	C9BA	09BD	49BD	09BE	C9BF
05	49E7	89E9	C9EA	09EB	49ED	09EE	C9EF	89F2	09F5	89F7	49F9	09FA	C9FD	89FD	C9FE	09FF
06	8B27	4B29	0B2A	CB2B	8B2D	CB2E	0B2F	4B32	CB35	4B37	8B39	CB3A	0B3D	4B3D	0B3E	CB3F
07	4B67	8B69	CB6A	0B6B	4B6D	0B6E	CB6F	8B72	0B75	8B77	4B79	0B7A	CB7D	8B7D	CB7E	0B7F
08	4BC7	8BC9	CBCA	0BCB	4BCD	0BCE	CBCF	8BD2	0BD5	8BD7	4BD9	0BDA	CBDD	8BDD	CBDE	0BDF
09	8E27	4E29	0E2A	CE2B	8E2D	CE2E	0E2F	4E32	CE35	4E37	8E39	CE3A	0E3D	4E3D	0E3E	CE3F
0A	4E67	8E69	CE6A	0E6B	4E6D	0E6E	CE6F	8E72	0E75	8E77	4E79	0E7A	CE7D	8E7D	CE7E	0E7F
0B	4EC7	8EC9	CECA	0ECB	4ECD	0ECE	CECF	8ED2	0ED5	8ED7	4ED9	0EDA	CEDD	8EDD	CEDE	0EDF
0C	5127	9129	D12A	112B	512D	112E	D12F	9132	1135	9137	5139	113A	D13D	913D	D13E	113F
0D	9167	5169	116A	D16B	916D	D16E	116F	5172	D175	5177	9179	D17A	117D	517D	117E	D17F
0E	91C7	51C9	11CA	D1CB	91CD	D1CE	11CF	51D2	D1D5	51D7	91D9	D1DA	11DD	51DD	11DE	D1DF
0F	5247	9249	D24A	124B	524D	124E	D24F	9252	1255	9257	5259	125A	D25D	925D	D25E	125F

Fig. 12

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
10	92A7	52A9	12AA	D2AB	92AD	D2AE	12AF	52B2	D2B5	52B7	92B9	D2BA	12BB	52BD	12BE	D2BF
11	52E7	92E9	D2EA	12EB	52ED	12EE	D2EF	92F2	12F5	92F7	52F9	12FA	D2FB	92FD	D2FE	12FF
12	9347	5349	134A	D34B	934D	D34E	134F	5352	D355	5357	9359	D35A	135B	535D	135E	D35F
13	53A7	93A9	D3AA	13AB	53AD	13AE	D3AF	93B2	13B5	93B7	53B9	13BA	D3BB	93BD	D3BE	13BF
14	93E7	53E9	13EA	D3EB	93ED	D3EE	13EF	53F2	D3F5	53F7	93F9	D3FA	13FB	53FD	13FE	D3FF
15	9527	5529	152A	D52B	952D	D52E	152F	5532	D535	5537	9539	D53A	153B	553D	153E	D53F
16	5567	9569	D56A	156B	556D	156E	D56F	9572	1575	9577	5579	157A	D57B	957D	D57E	157F
17	55C7	95C9	D5CA	15CB	55CD	15CE	D5CF	95D2	15D5	95D7	55D9	15DA	D5DB	95DD	D5DE	15DF
18	9647	5649	164A	D64B	964D	D64E	164F	5652	D655	5657	9659	D65A	165B	565D	165E	D65F
19	56A7	96A9	D6AA	16AB	56AD	16AE	D6AF	96B2	16B5	96B7	56B9	16BA	D6BB	96BD	D6BE	16BF
1A	96E7	56E9	16EA	D6EB	96ED	D6EE	16EF	56F2	D6F5	56F7	96F9	D6FA	16FB	56FD	16FE	D6FF
1B	5747	9749	D74A	174B	574D	174E	D74F	9752	1755	9757	5759	175A	D75B	975D	D75E	175F
1C	97A7	57A9	17AA	D7AB	97AD	D7AE	17AF	57B2	D7B5	57B7	97B9	D7BA	17BB	57BD	17BE	D7BF
1D	57E7	97E9	D7EA	17EB	57ED	17EE	D7EF	97F2	17F5	97F7	57F9	17FA	D7FB	97FD	D7FE	17FF
1E	9A27	5A29	1A2A	DA2B	9A2D	DA2E	1A2F	5A32	DA35	5A37	9A39	DA3A	1A3B	5A3D	1A3E	DA3F
1F	5A67	9A69	DA6A	1A6B	5A6D	1A6E	DA6F	9A72	1A75	9A77	5A79	1A7A	DA7B	9A7D	DA7E	1A7F

Fig. 13

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
20	5AC7	9AC9	DACA	1ACB	5ACD	1ACE	DACF	9AD2	1AD5	9AD7	5AD9	1ADA	DADB	9ADD	DADE	1ADF
21	9C47	5C49	1C4A	DC4B	9C4D	DC4E	1C4F	5C52	DC55	5C57	9C59	DC5A	1C5B	5C5D	1C5E	DC5F
22	5CA7	9CA9	DCAA	1CAB	5CAD	1CAE	DCAF	9CB2	1CB5	9CB7	5CB9	1CBA	DCBB	9CBD	DCBE	1CBF
23	9CE7	5CE9	1CEA	DCEB	9CED	DCEE	1CEF	5CF2	DCF5	5CF7	9CF9	DCFA	1CFB	5CFD	1CFE	DCFF
24	5D47	9D49	DD4A	1D4B	5D4D	1D4E	DD4F	9D52	1D55	9D57	5D59	1D5A	DD5B	9D5D	DD5E	1D5F
25	9DA7	5DA9	1DAA	DDAB	9DAD	DDAE	1DAF	5DB2	DDB5	5DB7	9DB9	DDBA	1DDB	5DBD	1DBE	DDBF
26	5DE7	9DE9	DDEA	1DEB	5DED	1DEE	DDEF	9DF2	1DF5	9DF7	5DF9	1DFA	DDFB	9DFD	DDFE	1DFF
27	9F27	5F29	1F2A	DF2B	9F2D	DF2E	1F2F	5F32	DF35	5F37	9F39	DF3A	1F3B	5F3D	1F3E	DF3F
28	5F67	9F69	DF6A	1F6B	5F6D	1F6E	DF6F	9F72	1F75	9F77	5F79	1F7A	DF7B	9F7D	DF7E	1F7F
29	5FC7	9FC9	DFCA	1FCB	5FCD	1FCE	DFCF	9FD2	1FD5	9FD7	5FD9	1FDA	DFDB	9FDD	DFDE	1FDF
2A	6227	A229	E22A	222B	622D	222E	E22F	A232	2235	A237	6239	223A	E23B	A23D	E23E	223F
2B	A267	6269	226A	E26B	A26D	E26E	226F	6272	E275	6277	A279	E27A	227B	627D	227E	E27F
2C	A2C7	62C9	22CA	E2CB	A2CD	E2CE	22CF	62D2	E2D5	62D7	A2D9	E2DA	22DB	62DD	22DE	E2DF
2D	6447	A449	E44A	244B	644D	244E	E44F	A452	2455	A457	6459	245A	E45B	A45D	E45E	245F
2E	A4A7	64A9	24AA	E4AB	A4AD	E4AE	24AF	64B2	E4B5	64B7	A4B9	E4BA	24DB	64BD	24BE	E4BF
2F	64E7	A4E9	E4EA	24EB	64ED	24EE	E4EF	A4F2	24F5	A4F7	64F9	24FA	E4FB	A4FD	E4FE	24FF

Fig. 14

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
30	A547	6549	254A	E54B	A54D	E54E	254F	6552	E555	6557	A559	E55A	255B	655D	255E	E55F
31	65A7	A5A9	E5AA	25AB	65AD	25AE	E5AF	A5B2	25B5	A5B7	65B9	25BA	E5BB	A5BD	E5BE	25BF
32	A5E7	65E9	25EA	E5EB	A5ED	E5EE	25EF	65F2	E5F5	65F7	A5F9	E5FA	25FB	65FD	25FE	E5FF
33	6727	A729	E72A	272B	672D	272E	E72F	A732	2735	A737	6739	273A	E73B	A73D	E73E	273F
34	A767	6769	276A	E76B	A76D	E76E	276F	6772	E775	6777	A779	E77A	277B	677D	277E	E77F
35	A7C7	67C9	27CA	E7CB	A7CD	E7CE	27CF	67D2	E7D5	67D7	A7D9	E7DA	27DB	67DD	27DE	E7DF
36	A927	6929	292A	E92B	A92D	E92E	292F	6932	E935	6937	A939	E93A	293B	693D	293E	E93F
37	6967	A969	E96A	296B	696D	296E	E96F	A972	2975	A977	6979	297A	E97B	A97D	E97E	297F
38	69C7	A9C9	E9CA	29CB	69CD	29CE	E9CF	A9D2	29D5	A9D7	69D9	29DA	E9DB	A9DD	E9DE	29DF
39	AA47	6A49	2A4A	EA4B	AA4D	EA4E	2A4F	6A52	EA55	6A57	AA59	EA5A	2A5B	6A5D	2A5E	EA5F
3A	6AA7	AAA9	EAAA	2AAB	6AAD	2AAE	EAAF	AAB2	2AB5	AAB7	6AB9	2ABA	EABB	AABD	EABE	2ABF
3B	AAE7	6AE9	2AEA	EAEB	AAED	EAEE	2AEF	6AF2	EAF5	6AF7	AAF9	EAFA	2AFB	6AFD	2AFE	EAFF
3C	6B47	AB49	EB4A	2B4B	6B4D	2B4E	EB4F	AB52	2B55	AB57	6B59	2B5A	EB5B	AB5D	EB5E	2B5F
3D	ABA7	6BA9	2BAA	EBAB	ABAD	EBAE	2BAF	6BB2	EBB5	6BB7	ABB9	EBBA	2BBB	6BBD	2BBE	EBBF
3E	6BE7	ABE9	EBEA	2BEB	6BED	2BEE	EBEF	ABF2	2BF5	ABF7	6BF9	2BFA	EBFB	ABFD	EBFE	2BFF
3F	6D27	AD29	ED2A	2D2B	6D2D	2D2E	ED2F	AD32	2D35	AD37	6D39	2D3A	ED3B	AD3D	ED3E	2D3F

Fig. 15

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
40	AD67	6D69	2D6A	ED6B	AD6D	ED6E	2D6F	6D72	ED75	6D77	AD79	ED7A	2D7B	6D7D	2D7E	ED7F
41	ADC7	6DC9	2DCA	EDCB	ADCD	EDCE	2DCF	6DD2	EDD5	6DD7	ADD9	EDDA	2DDB	6DDD	2DDE	EDDF
42	6E47	AE49	EE4A	2E4B	6E4D	2E4E	EE4F	AE52	2E55	AE57	6E59	2E5A	EE5B	AE5D	EE5E	2E5F
43	AEA7	6EA9	2EAA	EEAB	AEAD	EEAE	2EAF	6EB2	EEB5	6EB7	AEB9	EEBA	2EBB	6EBD	2EBE	EEBF
44	6EE7	AEE9	EEEA	2EEB	6EED	2EEE	EEEF	AEF2	2EF5	AEF7	6EF9	2EFA	EEFB	AEFD	EEFE	2EFF
45	AF47	6F49	2F4A	EF4B	AF4D	EF4E	2F4F	6F52	EF55	6F57	AF59	EF5A	2F5B	6F5D	2F5E	EF5F
46	6FA7	AFA9	EFAA	2FAB	6FAD	2FAE	EFAF	AFB2	2FB5	AFB7	6FB9	2FBA	EFBB	AFBD	EFBE	2FBF
47	AFE7	6FE9	2FEA	EFEB	AFED	EFEE	2FEF	6FF2	EFF5	6FF7	AFF9	EFFA	2FFB	6FFD	2FFE	EFFF
48	B227	7229	322A	F22B	B22D	F22E	322F	7232	F235	7237	B239	F23A	323B	723D	323E	F23F
49	7267	B269	F26A	326B	726D	326E	F26F	B272	3275	B277	7279	327A	F27B	B27D	F27E	327F
4A	72C7	B2C9	F2CA	32CB	72CD	32CE	F2CF	B2D2	32D5	B2D7	72D9	32DA	F2DB	B2DD	F2DE	32DF
4B	B447	7449	344A	F44B	B44D	F44E	344F	7452	F455	7457	B459	F45A	345B	745D	345E	F45F
4C	74A7	B4A9	F4AA	34AB	74AD	34AE	F4AF	B4B2	34B5	B4B7	74B9	34BA	F4BB	B4BD	F4BE	34BF
4D	B4E7	74E9	34EA	F4EB	B4ED	F4EE	34EF	74F2	F4F5	74F7	B4F9	F4FA	34FB	74FD	34FE	F4FF
4E	7547	B549	F54A	354B	754D	354E	F54F	B552	3555	B557	7559	355A	F55B	B55D	F55E	355F
4F	B5A7	75A9	35AA	F5AB	B5AD	F5AE	35AF	75B2	F5B5	75B7	B5B9	F5BA	35BB	75BD	35BE	F5BF

Fig. 16

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
50	75E7	B5E9	F5EA	35EB	75ED	35EE	F5EF	B5F2	35F5	B5F7	75F9	35FA	F5FB	B5FD	F5FE	35FF
51	B727	7729	372A	F72B	B72D	F72E	372F	7732	F735	7737	B739	F73A	373B	773D	373E	F73F
52	7767	B769	F76A	376B	776D	376E	F76F	B772	3775	B777	7779	377A	F77B	B77D	F77E	377F
53	77C7	B7C9	F7CA	37CB	77CD	37CE	F7CF	B7D2	37D5	B7D7	77D9	37DA	F7DB	B7DD	F7DE	37DF
54	7927	B929	F92A	392B	792D	392E	F92F	B932	3935	B937	7939	393A	F93B	B93D	F93E	393F
55	B967	7969	396A	F96B	B96D	F96E	396F	7972	F975	7977	B979	F97A	397B	797D	397E	F97F
56	B9C7	79C9	39CA	F9CB	B9CD	F9CE	39CF	79D2	F9D5	79D7	B9D9	F9DA	39DB	79DD	39DE	F9DF
57	7A47	BA49	FA4A	3A4B	7A4D	3A4E	FA4F	BA52	3A55	BA57	7A59	3A5A	FA5B	BA5D	FA5E	3A5F
58	BAA7	7AA9	3AAA	FAAB	BAAD	FAAE	3AAF	7AB2	FAB5	7AB7	BAB9	FABA	3ABB	7ABD	3ABE	FABF
59	7AE7	BAE9	FAEA	3AEB	7AED	3AEE	FAEF	BAF2	3AF5	BAF7	7AF9	3AFA	FAFB	BAFD	FAFE	3AFF
5A	BB47	7B49	3B4A	FB4B	BB4D	FB4E	3B4F	7B52	FB55	7B57	BB59	FB5A	3B5B	7B5D	3B5E	FB5F
5B	7BA7	BBA9	FBAA	3BAB	7BAD	3BAE	FBAF	BBB2	3BB5	BBB7	7BB9	3BBA	FBBB	BBBD	FBBE	3BBF
5C	BBE7	7BE9	3BEA	FBEB	BBED	FBEE	3BEF	7BF2	FBF5	7BF7	BBF9	FBFA	3BFB	7BFD	3BFE	FBFF
5D	BD27	7D29	3D2A	FD2B	BD2D	FD2E	3D2F	7D32	FD35	7D37	BD39	FD3A	3D3B	7D3D	3D3E	FD3F
5E	7D67	BD69	FD6A	3D6B	7D6D	3D6E	FD6F	BD72	3D75	BD77	7D79	3D7A	FD7B	BD7D	FD7E	3D7F
5F	7DC7	BDC9	FDCA	3DCB	7DCD	3DCE	FDCF	BDD2	3DD5	BDD7	7DD9	3DDA	FDDB	BDDD	FDDE	3DDF

Fig. 17

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
60	BE47	7E49	3E4A	FE4B	BE4D	FE4E	3E4F	7E52	FE55	7E57	BE59	FE5A	3E5B	7E5D	3E5E	FE5F
61	7EA7	BEA9	FEAA	3EAB	7EAD	3EAE	FEAF	BEB2	3EB5	BEB7	7EB9	3EBA	FEBB	BEBD	FEBE	3EBF
62	BEE7	7EE9	3EEA	FEEB	BEED	FEEE	3EEF	7EF2	FEF5	7EF7	BEF9	FEFA	3EFB	7EFD	3EFE	FEFF
63	7F47	BF49	FF4A	3F4B	7F4D	3F4E	FF4F	BF52	3F55	BF57	7F59	3F5A	FF5B	BF5D	FF5E	3F5F
64	BFA7	7FA9	3FAA	FFAB	BFAD	FFAE	3FAF	7FB2	FFB5	7FB7	BFB9	FFBA	3FBB	7FBD	3FBE	FFBF
65	7FE7	BFE9	FFEA	3FEB	7FED	3FEE	FFEF	BFF2	3FF5	BFF7	7FF9	3FFA	FFFB	BFFD	FFFE	3FFF
66	4A87	8A89	CA8A	0A8B	4A8D	0A8E	CA8F	8A92	0A95	8A97	4A99	0A9A	CA9B	8A9D	CA9E	0A9F
67	4F87	8F89	CF8A	0F8B	4F8D	0F8E	CF8F	8F92	0F95	8F97	4F99	0F9A	CF9B	8F9D	CF9E	0F9F
68	9087	5089	108A	D08B	908D	D08E	108F	5092	D095	5097	9099	D09A	109B	509D	109E	D09F
69	5487	9489	D48A	148B	548D	148E	D48F	9492	1495	9497	5499	149A	D49B	949D	D49E	149F
6A	5B87	9B89	DB8A	1B8B	5B8D	1B8E	DB8F	9B92	1B95	9B97	5B99	1B9A	DB9B	9B9D	DB9E	1B9F
6B	5E87	9E89	DE8A	1E8B	5E8D	1E8E	DE8F	9E92	1E95	9E97	5E99	1E9A	DE9B	9E9D	DE9E	1E9F
6C	A387	6389	238A	E38B	A38D	E38E	238F	6392	E395	6397	A399	E39A	239B	639D	239E	E39F
6D	A687	6689	268A	E68B	A68D	E68E	268F	6692	E695	6697	A699	E69A	269B	669D	269E	E69F
6E	6887	A889	E88A	288B	688D	288E	E88F	A892	2895	A897	6899	289A	E89B	A89D	E89E	289F
6F	AC87	6C89	2C8A	EC8B	AC8D	EC8E	2C8F	6C92	EC95	6C97	AC99	EC9A	2C9B	6C9D	2C9E	EC9F

Fig. 18

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
70	7387	B389	F38A	338B	738D	338E	F38F	B392	3395	B397	7399	339A	F39B	B39D	F39E	339F
71	7687	B689	F68A	368B	768D	368E	F68F	B692	3695	B697	7699	369A	F69B	B69D	F69E	369F
72	B887	7889	388A	F88B	B88D	F88E	388F	7892	F895	7897	B899	F89A	389B	789D	389E	F89F
73	7C87	BC89	FC8A	3C8B	7C8D	3C8E	FC8F	BC92	3C95	BC97	7C99	3C9A	FC9B	BC9D	FC9E	3C9F
74	0927	C869	892A	486B	092D	486E	892F	C872	4875	C877	0939	487A	893B	C87D	893E	487F
75	0AE7	0889	8AEA	888B	0AED	888E	8AEF	0892	8895	0897	0AF9	889A	8AFB	089D	8AFE	889F
76	0BA7	C8C9	8BAA	48CB	0BAD	48CE	8BAF	C8D2	48D5	C8D7	0BB9	48DA	8BBB	C8DD	8BBE	48DF
77	0D67	0969	8D6A	896B	0D6D	896E	8D6F	0972	8975	0977	0D79	897A	8D7B	097D	8D7E	897F
78	0EA7	C989	8EAA	498B	0EAD	498E	8EAF	C992	4995	C997	0EB9	499A	8EDB	C99D	8EBE	499F
79	0FE7	09C9	8FEA	89CB	0FED	89CE	8FEF	09D2	89D5	09D7	0FF9	89DA	8FFB	09DD	8FFE	89DF
7A	D0E7	0AA9	50EA	8AAB	D0ED	8AAE	50EF	0AB2	8AB5	0AB7	D0F9	8ABA	50FB	0ABD	50FE	8ABF
7B	D1A7	CB09	51AA	4B0B	D1AD	4B0E	51AF	CB12	4B15	CB17	D1B9	4B1A	51BB	CB1D	51BE	4B1F
7C	1227	0B49	922A	8B4B	122D	8B4E	922F	0B52	8B55	0B57	1239	8B5A	923B	0B5D	923E	8B5F
7D	D327	0BE9	532A	8BEB	D32D	8BEE	532F	0BF2	8BF5	0BF7	D339	8BFA	533B	0BFD	533E	8BFF
7E	14E7	0D29	94EA	8D2B	14ED	8D2E	94EF	0D32	8D35	0D37	14F9	8D3A	94FB	0D3D	94FE	9D3F
7F	15A7	0E49	95AA	8E4B	15AD	8E4E	95AF	0E52	8E55	0E57	15B9	8E5A	95BB	0E5D	95BE	8E5F

Fig. 19

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
80	D627	0EE9	562A	8EEB	D62D	82EE	562F	0EF2	8EF5	0EF7	D639	8EFA	563B	0EFD	563E	82FF
81	1727	0FA9	972A	8FAB	172D	8FAE	972F	0FB2	8FB5	0FB7	1739	8FBA	973B	0FBD	973E	8FBF
82	1967	D0A9	996A	50AB	196D	50AE	996F	D0B2	50B5	D0B7	1979	50BA	997B	D0BD	997E	50BF
83	1AA7	1109	9AAA	910B	1AAD	910E	9AAF	1112	9115	1117	1AB9	911A	9ABB	111D	9ABE	911F
84	1BE7	D149	9BEA	514B	1BED	514E	9BEF	D152	5155	D157	1BF9	515A	9BFB	D15D	9BFE	515F
85	DC27	D1E9	5C2A	51EB	DC2D	51EE	5C2F	D1F2	51F5	D1F7	DC39	51FA	5C3B	D1FD	5C3E	51FF
86	1D27	1269	9D2A	926B	1D2D	926E	9D2F	1272	9275	1277	1D39	927A	9D3B	127D	9D3E	927F
87	1EE7	D289	9EEA	528B	1EED	528E	9EEF	D292	5295	D297	1EF9	529A	9EFB	D29D	9EFE	529F
88	1FA7	12C9	9FAA	92CB	1FAD	92CE	9FAF	12D2	92D5	12D7	1FB9	92DA	9FBB	12DD	9FBE	92DF
89	E167	D369	616A	536B	E16D	536E	616F	D372	5375	D377	E179	537A	617B	D37D	617E	537F
8A	E2A7	1389	62AA	938B	E2AD	938E	62AF	1392	9395	1397	E2B9	939A	62BB	139D	62BE	939F
8B	E3E7	D3C9	63EA	53CB	E3ED	53CE	63EF	D3D2	53D5	D3D7	E3F9	53DA	63FB	D3DD	63FE	53DF
8C	2427	14A9	A42A	94AB	242D	94AE	A42F	14B2	94B5	14B7	2439	94BA	A43B	14BD	A43E	94BF
8D	E527	D509	652A	550B	E52D	550E	652F	D512	5515	D517	E539	551A	653B	D51D	653E	551F
8E	E6E7	1549	66EA	954B	E6ED	954E	66EF	1552	9555	1557	E6F9	955A	66FB	155D	66FE	955F
8F	E7A7	15E9	67AA	95EB	E7AD	95EE	67AF	15F2	95F5	15F7	E7B9	95FA	67BB	15FD	67BE	95FF

Fig. 20

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
90	28E7	D669	A8EA	566B	28ED	566E	A8EF	D672	5675	D677	28F9	567A	A8FB	D67D	A8FE	567F
91	29A7	1689	A9AA	968B	29AD	968E	A9AF	1692	9695	1697	29B9	969A	A9BB	169D	A9BE	969F
92	EA27	D6C9	6A2A	56CB	EA2D	56CE	6A2F	D6D2	56D5	D6D7	EA39	56DA	6A3B	D6DD	6A3E	56DF
93	2B27	1769	AB2A	976B	2B2D	976E	AB2F	1772	9775	1777	2B39	977A	AB3B	177D	AB3E	977F
94	ECE7	D789	6CEA	578B	ECED	578E	6CEF	D792	5795	D797	ECF9	579A	6CFB	D79D	6CFE	579F
95	EDA7	17C9	6DAA	97CB	EDAD	97CE	6DAF	17D2	97D5	17D7	EDB9	97DA	6DBB	17DD	6DBE	97DF
96	2E27	1929	AE2A	992B	2E2D	992E	AE2F	1932	9935	1937	2E39	993A	AE3B	193D	AE3E	993F
97	EF27	1A49	6F2A	9A4B	EF2D	9A4E	6F2F	1A52	9A55	1A57	EF39	9A5A	6F3B	1A5D	6F3E	9A5F
98	3167	1AE9	B16A	9AEB	316D	9AEE	B16F	1AF2	9AF5	1AF7	3179	9AFA	B17B	1AFD	B17E	9AFF
99	32A7	1BA9	B2AA	9BAB	32AD	9BAE	B2AF	1BB2	9BB5	1BB7	32B9	9BBA	B2BB	1BBD	B2BE	9BBF
9A	33E7	DC69	B3EA	5C6B	33ED	5C6E	B3EF	DC72	5C75	DC77	33F9	5C7A	B3FB	DC7D	B3FE	5C7F
9B	F427	1C89	742A	9C8B	F42D	9C8E	742F	1C92	9C95	1C97	F439	9C9A	743B	1C9D	743E	9C9F
9C	3527	DCC9	B52A	5CCB	352D	5CCE	B52F	DCD2	5CD5	DCD7	3539	5CDA	B53B	DCDD	B53E	5CDF
9D	36E7	1D69	B6EA	9D6B	36ED	9D6E	B6EF	1D72	9D75	1D77	36F9	9D7A	B6FB	1D7D	B6FE	9D7F
9E	37A7	DD89	B7AA	5D8B	37AD	5D8E	B7AF	DD92	5D95	DD97	37B9	5D9A	B7BB	DD9D	B7BE	5D9F
9F	F8E7	1DC9	78EA	9DCB	F8ED	9DCE	78EF	1DD2	9DD5	1DD7	F8F9	9DDA	78FB	1DDD	78FE	9DDF

Fig. 21

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
A0	F9A7	1EA9	79AA	9EAB	F9AD	9EAE	79AF	1EB2	9EB5	1EB7	F9B9	9EBA	79BB	1EBD	79BE	9EBF
A1	3A27	DF09	BA2A	5F0B	3A2D	5F0E	BA2F	DF12	5F15	DF17	3A39	5F1A	BA3B	DF1D	BA3E	5F1F
A2	FB27	1F49	7B2A	9F4B	FB2D	9F4E	7B2F	1F52	9F55	1F57	FB39	9F5A	7B3B	1F5D	7B3E	9F5F
A3	3CE7	1FE9	BC2A	9FEB	3CED	9FEE	BC2F	1FF2	9FF5	1FF7	3CF9	9FFA	BCFB	1FFD	BCFE	9FFF
A4	3DA7	E129	BDAA	612B	3DAD	612E	BDAF	E132	6135	E137	3DB9	613A	BDBB	E13D	BDBE	613F
A5	FE27	E249	7E2A	624B	FE2D	624E	7E2F	E252	6255	E257	FE39	625A	7E3B	E25D	7E3E	625F
A6	3F27	E2E9	BF2A	62EB	3F2D	62EE	BF2F	E2F2	62F5	E2F7	3F39	62FA	BF3B	E2FD	BF3E	62FF
A7	0A47	E3A9	1A4A	63AB	0A4D	63AE	8A4F	E3B2	63B5	E3B7	0A59	63BA	8A5B	E3BD	8A5E	63BF
A8	0DC7	2469	8DCA	A46B	0DCD	A46E	8DCF	2472	A475	2477	0DD9	A47A	8DDB	247D	8DDE	A47F
A9	0F47	E489	8F4A	648B	0F4D	648E	8F4F	E492	6495	E497	0F59	649A	8F5B	E49D	8F5E	649F
AA	1447	24C9	944A	A4CB	144D	A4CE	944F	24D2	A4D5	24D7	1459	A4DA	945B	24DD	945E	A4DF
AB	19C7	E569	99CA	656B	19CD	656E	99CF	E572	6575	E577	19D9	657A	99DB	E57D	99DE	657F
AC	1B47	2589	9B4A	A58B	1B4D	A58E	9B4F	2592	A595	2597	1B59	A59A	9B5B	259D	9B5E	A59F
AD	1E47	E5C9	9E4A	65CB	1E4D	65CE	9E4F	E5D2	65D5	E5D7	1E59	65DA	9E5B	E5DD	9E5E	65DF
AE	E1C7	E6A9	61CA	66AB	E1CD	66AE	61CF	E6B2	66B5	E6B7	E1D9	66BA	61DB	E6BD	61DE	66BF
AF	E347	2709	634A	A70B	E34D	A70E	634F	2712	A715	2717	E359	A71A	635B	271D	635E	A71F

Fig. 22

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
B0	E647	E749	664A	674B	E64D	674E	664F	E752	6755	E757	E659	675A	665B	E75D	665E	675F
B1	2847	E7E9	A84A	67EB	284D	67EE	A84F	E7F2	67F5	E7F7	2859	67FA	A85B	E7FD	A85E	67FF
B2	EC47	28A9	6C4A	A8AB	EC4D	A8AE	6C4F	28B2	A8B5	21B7	EC59	A8BA	6C5B	28BD	6C5E	A8BF
B3	31C7	E909	B1CA	690B	31CD	690E	B1CF	E912	6915	E917	31D9	691A	B1DB	E91D	B1CE	691F
B4	3347	2949	B34A	A94B	334D	A94E	B34F	2952	A955	2957	3359	A95A	B35B	295D	B35E	A95F
B5	3647	29E9	B64A	A9EB	364D	A9EE	B64F	29F2	A9F5	29F7	3659	A9FA	B65B	29FD	B65E	A9FF
B6	F847	EA69	784A	6A6B	F84D	6A6E	784F	EA72	6A75	EA77	F859	6A7A	785B	EA7D	785E	6A7F
B7	3C47	2A89	BC4A	AA8B	3C4D	AA8E	BC4F	2A92	AA95	2A97	3C59	AA9A	BC5B	2A9D	BC5E	AA9F
B8	0C87	EAC9	8C8A	6ACB	0C8D	6ACE	8C8F	EAD2	6AD5	EAD7	0C99	6ADA	8C9B	EADD	8C9E	6ADF
B9	1887	2B69	988A	AB6B	188D	AB6E	988F	2B72	AB75	2B77	1899	AB7A	989B	2B7D	989E	AB7F
BA	3087	EB89	B08A	6B8B	308D	6B8E	B08F	EB92	6B95	EB97	3099	6B9A	B09B	EB9D	B09E	6B9F
BB	4921	2BC9	C923	ABCB	8925	ABCE	C926	2BD2	ABD5	2BD7	0911	ABDA	8913	2BDD	8916	ABDF
BC	4AE1	ECA9	CAE3	6CAB	8AE5	6CAE	CAE6	ECB2	6CB5	ECB7	0A71	6CBA	8A73	ECBD	8A76	6CBF
BD	4BA1	2D09	CBA3	AD0B	8BA5	AD0E	CBA6	2D12	AD15	2D17	0AD1	AD1A	8AD3	2D1D	8AD6	AD1F
BE	4D61	ED49	CD63	6D4B	8D65	6D4E	CD66	ED52	6D55	ED57	0B91	6D5A	8B93	ED5D	8B96	6D5F
BF	4EA1	EDE9	CEA3	6DEB	8EA5	6DEE	CEA6	EDF2	6DF5	EDF7	0CB1	6DFA	8CB3	EDFD	8CB6	6DFF

Fig. 23

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
C0	4FE1	2E69	CFE3	AE6B	8FE5	AE6E	CFE6	2E72	AE75	2E77	0D51	AE7A	8D73	2E7D	8D76	AE7F
C1	90E1	EE89	10E3	6E8B	50E5	6E8E	10E6	EE92	6E95	EE97	0DF1	6E9A	8D93	EE9D	8D96	6E9F
C2	91A1	2EC9	11A3	AECB	51A5	AECE	11A6	2ED2	AED5	2ED7	0E91	AEDA	8ED3	2EDD	8ED6	AEDF
C3	5221	EF69	D223	6F6B	9225	6F6E	D226	EF72	6F75	EF77	0F71	6F7A	8F73	EF7D	8F76	6F7F
C4	9321	2F89	1323	AF8B	5325	AF8E	1326	2F92	AF95	2F97	0FD1	AF9A	8F93	2F9D	8F96	AF9F
C5	54E1	EFC9	D4E3	6FCB	94E5	6FCE	D4E6	EFD2	6FD5	EFD7	D0D1	6FDA	50D3	EFDD	50D6	6FDF
C6	55A1	3129	D5A3	B12B	95A5	B12E	D5A6	3132	B135	3137	D191	B13A	5133	313D	5136	B13F
C7	9621	3249	1623	B24B	5625	B24E	1626	3252	B255	3257	1211	B25A	9253	325D	9256	B25F
C8	5721	32E9	D723	B2EB	9725	B2EE	D726	32F2	B2F5	32F7	D311	B2FA	53F3	32FD	53F6	B2FF
C9	5961	33A9	D963	B3AB	9965	B3AE	D966	33B2	B3B5	33B7	1471	B3BA	94B3	33BD	94B6	B3BF
CA	5AA1	F469	DAA3	746B	9AA5	746E	DAA6	F472	7475	F477	14D1	747A	9473	F47D	9476	747F
CB	5BE1	3489	DBE3	B48B	9BE5	B48E	DBE6	3492	B495	3497	1591	B49A	9593	349D	9596	B49F
CC	9C21	F4C9	1C23	74CB	5C25	74CE	1C26	F4D2	74D5	F4D7	D611	74DA	56D3	F4DD	56D6	74DF
CD	5D21	3569	DD23	B56B	9D25	B56E	DD26	3572	B575	3577	1711	B57A	9773	357D	9776	B57F
CE	5EE1	F589	DEE3	758B	9EE5	758E	DEE6	F592	7595	F597	18B1	759A	9893	F59D	9896	759F
CF	5FA1	35C9	DFA3	B5CB	9FA5	B5CE	DFA6	35D2	B5D5	35D7	1951	B5DA	99D3	35DD	99D6	B5DF

Fig. 24

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
D0	A161	36A9	2163	B6AB	6165	B6AE	2166	36B2	B6B5	36B7	19F1	B6BA	99F3	36BD	99F6	B6BF
D1	A2A1	F709	22A3	770B	62A5	770E	22A6	F712	7715	F717	1A91	771A	9A93	F71D	9A96	771F
D2	A3E1	3749	23E3	B74B	63E5	B74E	23E6	3752	B755	3757	1B71	B75A	9B73	375D	9B76	B75F
D3	6421	37E9	E423	B7EB	A425	B7EE	E426	37F2	B7F5	37F7	1BD1	B7FA	9BD3	37FD	9BD6	B7FF
D4	A521	F8A9	2523	78AB	6525	78AE	2526	F8B2	78B5	F8B7	1D11	78BA	9D13	F8BD	9D16	78BF
D5	A6E1	3909	26E3	B90B	66E5	B90E	26E6	3912	B915	3917	1E71	B91A	9E73	391D	9E76	B91F
D6	A7A1	F949	27A3	794B	67A5	794E	27A6	F952	7955	F957	1ED1	795A	9ED3	F95D	9ED6	795F
D7	68E1	F9E9	E8E3	79EB	A8E5	79EE	E8E6	F9F2	79F5	F9F7	1F91	79FA	9F93	F9FD	9F96	79FF
D8	69A1	3A69	E9A3	BA6B	A9A5	BA6E	E9A6	3A72	BA75	3A77	E151	BA7A	6153	3A7D	6156	BA7F
D9	AA21	FA89	2A23	7A8B	6A25	7A8E	2A26	FA92	7A95	FA97	E1F1	7A9A	61F3	FA9D	61F6	7A9F
DA	6B21	3AC9	EB23	BACB	AB25	BACE	EB26	3AD2	BAD5	3AD7	E291	BADA	6293	3ADD	6296	BADF
DB	ACE1	FB69	2CE3	7B6B	6CE5	7B6E	2CE6	FB72	7B75	FB77	E371	7B7A	6373	FB7D	6376	7B7F
DC	ADA1	3B89	2DA3	BB8B	6DA5	BB8E	2DA6	3B92	BB95	3B97	E3D1	BB9A	63D3	3B9D	63D6	BB9F
DD	6EE1	FBC9	EEE3	7BCB	AEE5	7BCE	EEE6	FBD2	7BD5	FBD7	E511	7BDA	6513	FBDD	6516	7BDF
DE	AFE1	3CA9	2FE3	BCAB	6FE5	BCAE	2FE6	3CB2	BCB5	3CB7	E671	BCBA	6673	3CBD	6676	BCBF
DF	7161	FD09	F163	7D0B	B165	7D0E	F166	FD12	7D15	FD17	E6D1	7D1A	66D3	FD1D	66D6	7D1F

Fig. 25

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
E0	72A1	3D49	F2A3	BD4B	B2A5	BD4E	F2A6	3D52	BD55	3D57	E791	BD5A	6793	3D5D	6796	BD5F
E1	73E1	3DE9	F3E3	BDEB	B3E5	BDEE	F3E6	3DF2	BDF5	3DF7	2871	BDFA	A873	3DFD	A876	BDFF
E2	B421	FE69	3423	7E6B	7425	7E6E	3426	FE72	7E75	FE77	28D1	7E7A	A8D3	FE7D	A8D6	7E7F
E3	7521	3E89	F523	BE8B	B525	BE8E	F526	3E92	BE95	3E97	2991	BE9A	A993	3E9D	A996	BE9F
E4	76E1	FEC9	F6E3	7ECB	B6E5	7ECE	F6E6	FED2	7ED5	FED7	EA11	7EDA	6A13	FEDD	6A16	7EDF
E5	77A1	3F69	F7A3	BF6B	B7A5	BF6E	F7A6	3F72	BF75	3F77	2B11	BF7A	AB13	3F7D	AB16	BF7F
E6	B8E1	FF89	38E3	7F8B	78E5	7F8E	38E6	FF92	7F95	FF97	EC71	7F9A	6C73	FF9D	6C76	7F9F
E7	B9A1	3FC9	39A3	BFCB	79A5	BFCE	39A6	3FD2	BFD5	3FD7	ECD1	BFDA	6CD3	3FDD	6CD6	BFDF
E8	7A21	90B1	FA23	10B3	BA25	10B6	FA26	A131	2133	2136	ED91	7131	6D93	F133	6D96	F13F
E9	BB21	5111	3B23	D113	7B25	D116	3B26	A251	2253	2256	2E11	7251	AE13	F253	AE16	F25F
EA	7CE1	9151	FCE3	1153	BCE5	1156	FCE6	A2F1	22F3	22F6	EF11	72F1	6F13	F2F3	6F16	F2FF
EB	7DA1	91F1	FDA3	11F3	BDA5	11F6	FDA6	A3B1	23B3	23B6	30B1	73B1	B0B3	F3B3	B0B6	F3BF
EC	BE21	5271	3E23	D273	7E25	D276	3E26	6471	E473	E476	3151	B471	B153	3473	B156	347F
ED	7F21	9291	FF23	1293	BF25	1296	FF26	A491	2493	2496	31F1	7491	B1F3	F493	B1F6	F49F
EE	0A21	52D1	8A23	D2D3	BA45	D2D6	8A26	64D1	E4D3	E4D6	3291	B4D1	B293	34D3	B296	34DF
EF	0CE1	9371	8CE3	1373	BDC5	1376	8CE6	A571	2573	2576	3371	7571	B373	F573	B376	F57F

Fig. 26

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
F0	1DA1	5391	8DA3	D393	8F45	D396	8DA6	6591	E593	E596	33D1	B591	B3D3	3593	B3D6	3596
F1	1F21	93D1	8F23	13D3	9445	13D6	8F26	A5D1	25D3	25D6	3511	75D1	B513	F5D3	B516	F5D6
F2	1421	54B1	9423	D4B3	98C5	D4B6	9426	A6B1	26B3	26B6	3671	76B1	B673	F6B3	B676	F6B6
F3	18E1	9511	98E3	1513	9B45	1516	98E6	6711	E713	E716	36D1	B711	B6D3	3713	B6D6	3716
F4	19A1	5551	99A3	D553	9E45	D556	99A6	A751	2753	2756	3791	7751	B793	F753	B796	F756
F5	1B21	55F1	9B23	D5F3	61C5	D5F6	9B26	A7F1	27F3	27F6	F871	77F1	7873	F7F3	7876	F7F6
F6	1E21	9671	9E23	1673	6345	1676	9E26	68B1	E8B3	E8B6	F8D1	B8B1	78D3	38B3	78D6	38B6
F7	E1A1	5691	61A3	D693	6645	D696	61A6	A911	2913	2916	F991	7911	7993	F913	7996	F916
F8	E321	96D1	6323	16D3	A845	16D6	6326	6951	E953	E956	3A11	B951	BA13	3953	BA16	3956
F9	E621	5771	6623	D773	6C45	D776	6626	69F1	E9F3	E9F6	FB11	B9F1	7B13	39F3	7B16	39F6
FA	EC21	9791	6C23	1793	B1C5	1796	6C26	AA71	2A73	2A76	3C71	7A71	BC73	FA73	BC76	FA76
FB	30E1	57D1	B0E3	D7D3	B345	D7D6	B0E6	6A91	EA93	EA96	3CD1	BA91	BCD3	3A93	BCD6	3A96
FC	31A1	5931	B1A3	D933	B645	D936	B1A6	AAD1	2AD3	2AD6	3D91	7AD1	BD93	FAD3	BD96	FAD6
FD	3321	5A51	B323	DA53	7845	DA56	B326	6B71	EB73	EB76	FE11	BB71	7E13	3B73	7E16	3B76
FE	3621	5AF1	B623	DAF3	BC45	DAF6	B626	AB91	2B93	2B96	3F11	7B91	BF13	FB93	BF16	FB96
FF	3C21	5BB1	BC23	DBB3	8C85	DBB6	BC26	6BD1	EBD3	EBD6	8E11	BBD1	0E13	3BD3	0E16	3BD6

Fig. 27

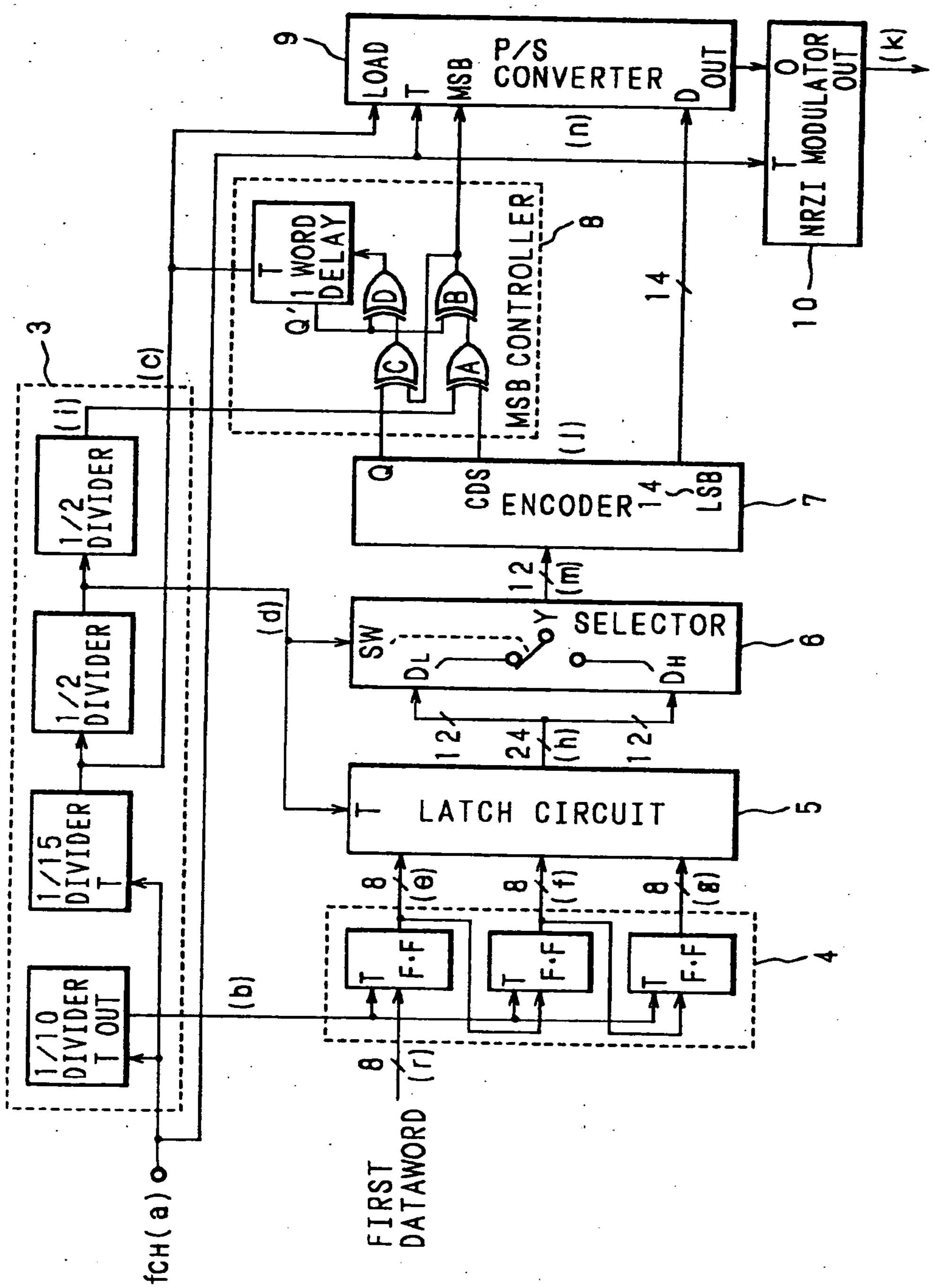

P/S CONVERTER
LOAD
T
MSB
D
OUT
9
O
OUT
NRZI MODULATOR
T
10
(k)
(n)
14
T
1 WORD DELAY
Q'
D
B
C
A
MSB CONTROLLER
8
(l)
(j)
(c)
3
1/2 DIVIDER
1/2 DIVIDER
1/15 DIVIDER
T
1/10 DIVIDER
T OUT
(b)
(d)
Q
CDS
ENCODER
14
LSB
7
12
(m)
SW
Y
SELECTOR
DL
DH
6
12
24
(h)
12
T
LATCH CIRCUIT
5
8
(e)
8
(f)
8
(g)
T
F·F
T
F·F
T
F·F
4
8
(r)
fCH(a)
FIRST DATAWORD

Fig. 28(A)

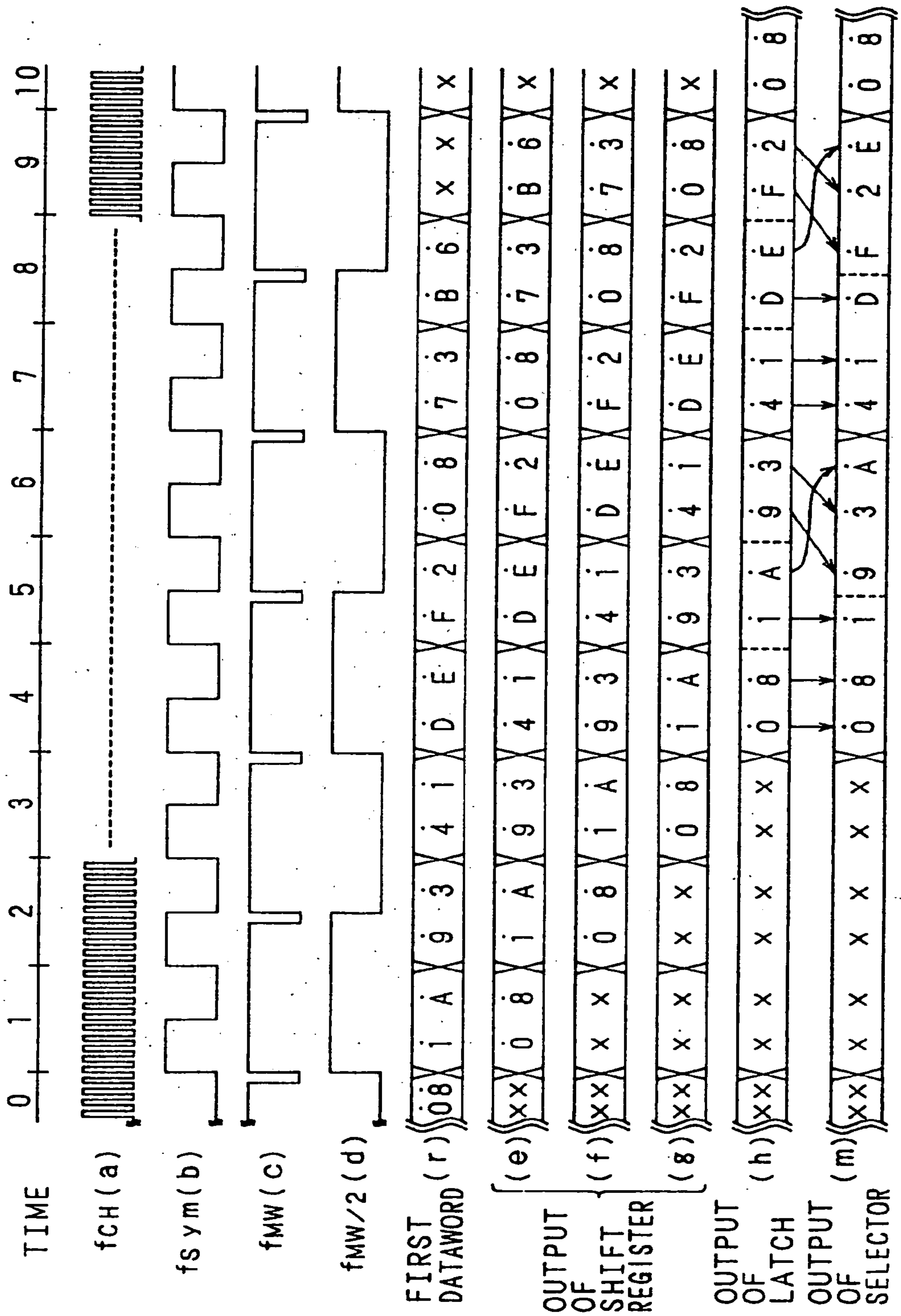

TIME
0
1
2
3
4
5
6
7
8
9
10
fCH (a)
fSym (b)
fMW (c)
fMW/2 (d)
FIRST DATAWORD (r)
OUTPUT OF SHIFT REGISTER
(e)
(f)
(g)
OUTPUT OF LATCH (h)
OUTPUT OF SELECTOR (m)

Fig. 28(B)

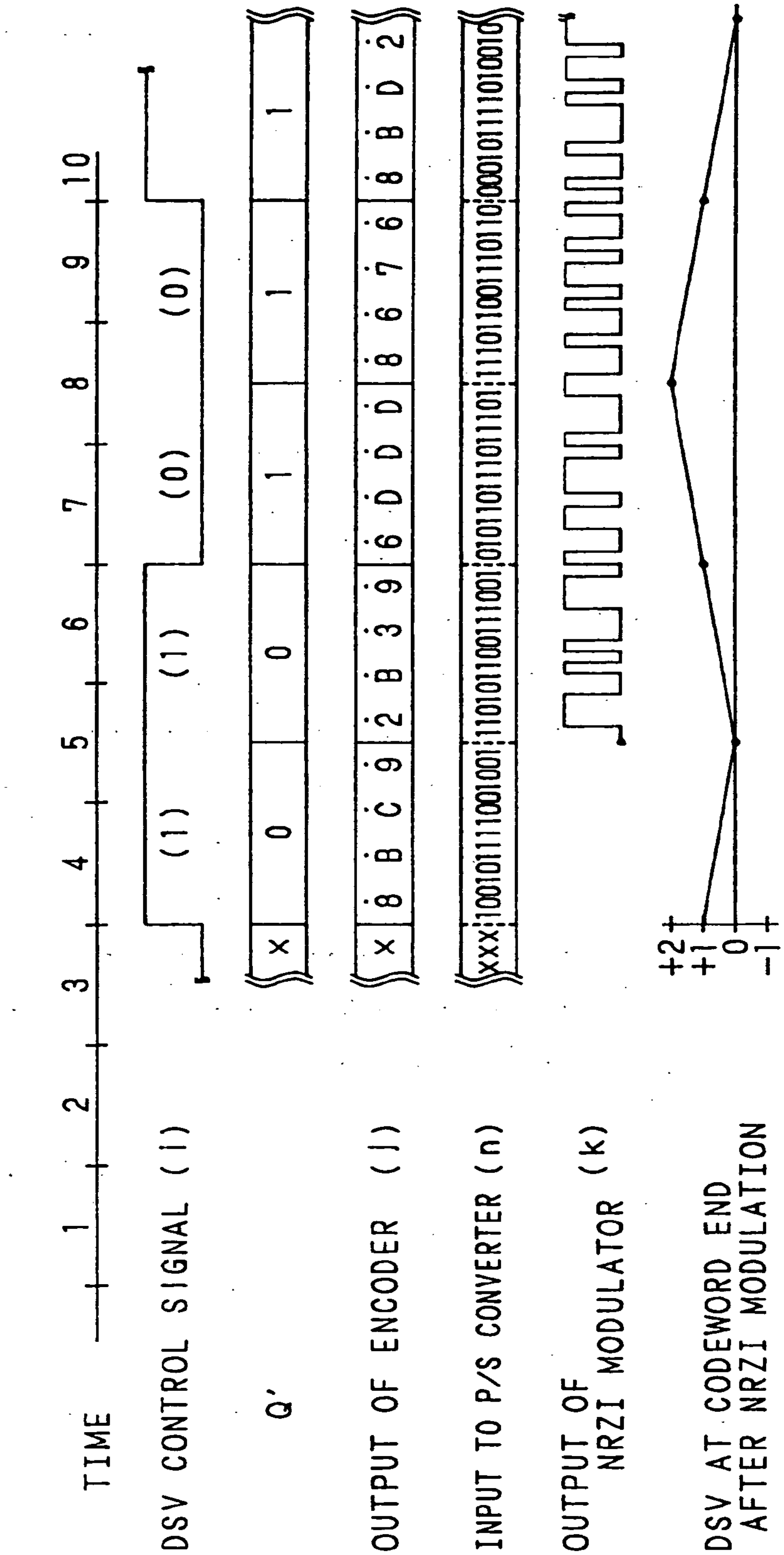

TIME
1
2
3
4
5
6
7
8
9
10
DSV CONTROL SIGNAL (l)
(1)
(1)
(0)
(0)
Q'
x
0
0
1
1
1
OUTPUT OF ENCODER (j)
x 8 B C 9 2 B 3 9 6 D D D 8 6 7 6 8 B D 2
INPUT TO P/S CONVERTER (n)
OUTPUT OF NRZI MODULATOR (k)
DSV AT CODEWORD END AFTER NRZI MODULATION
+2
+1
0
-1

Fig. 29

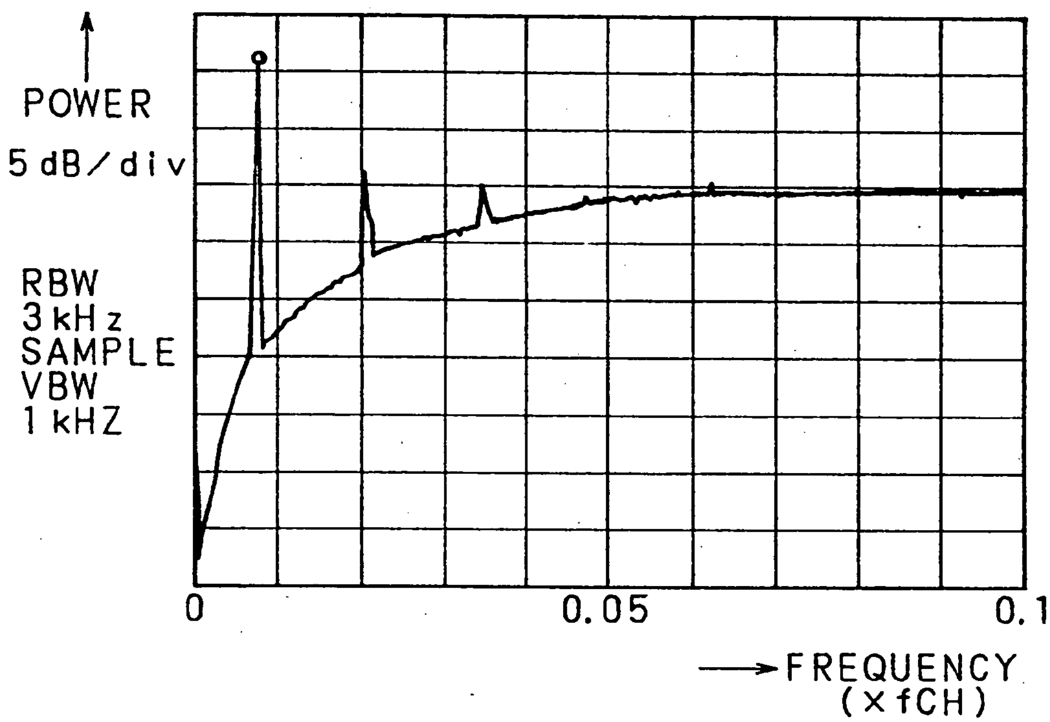
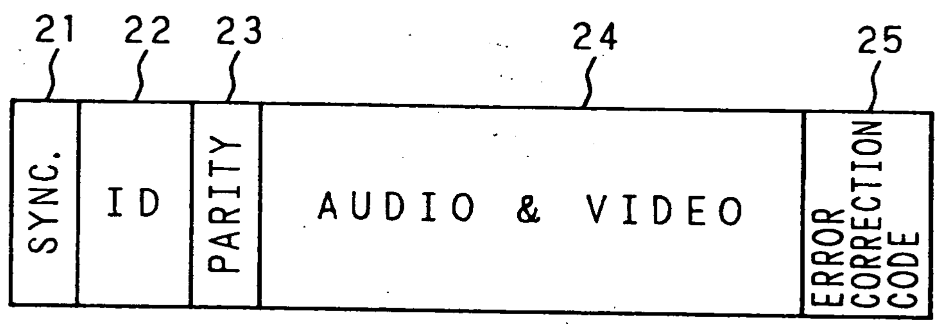


Fig. 30


21
22
23
24
25
SYNC.
ID
PARITY
AUDIO & VIDEO
ERROR CORRECTION CODE

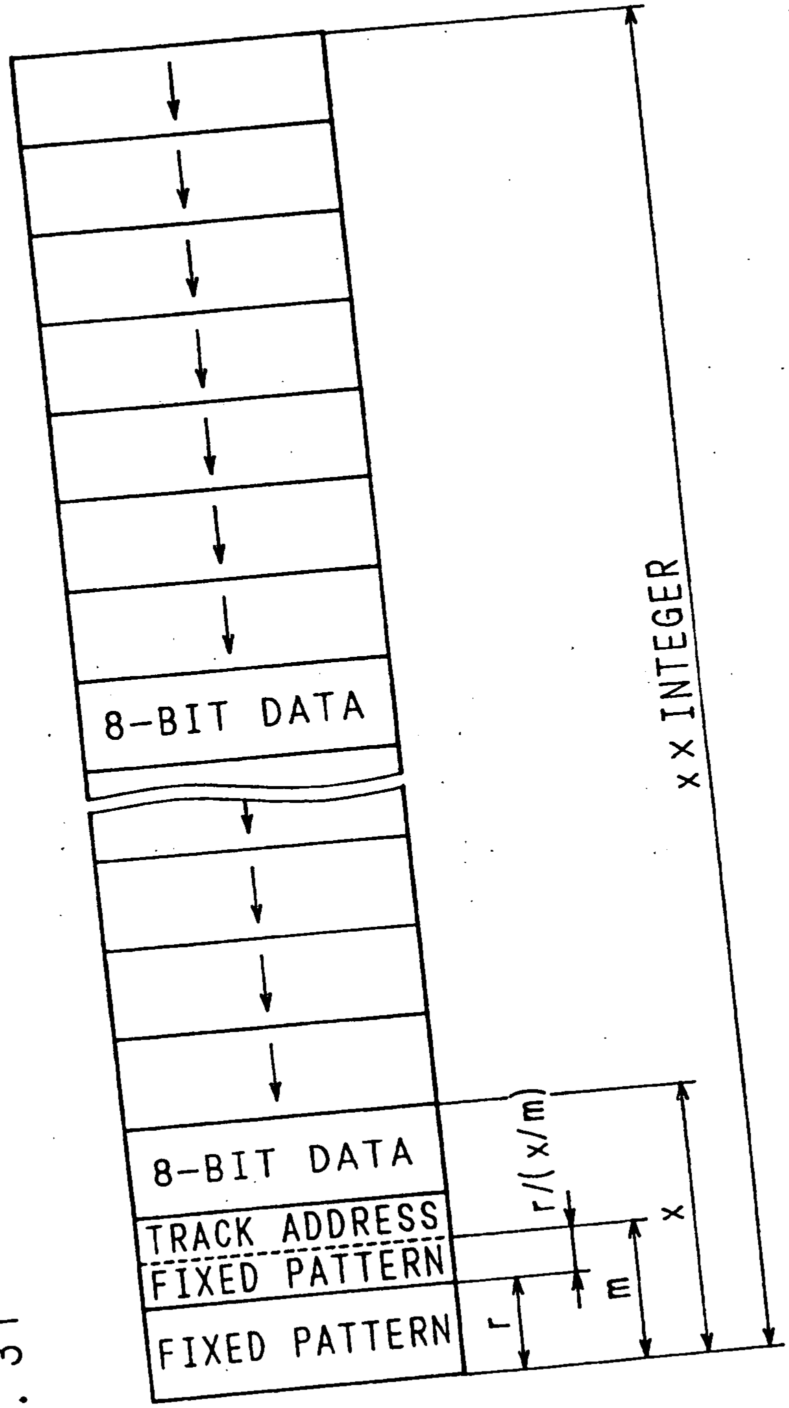

8-BIT DATA
8-BIT DATA
TRACK ADDRESS
FIXED PATTERN
FIXED PATTERN
x × INTEGER
r/(x/m)
x
m
r

Fig. 31

Fig. 32

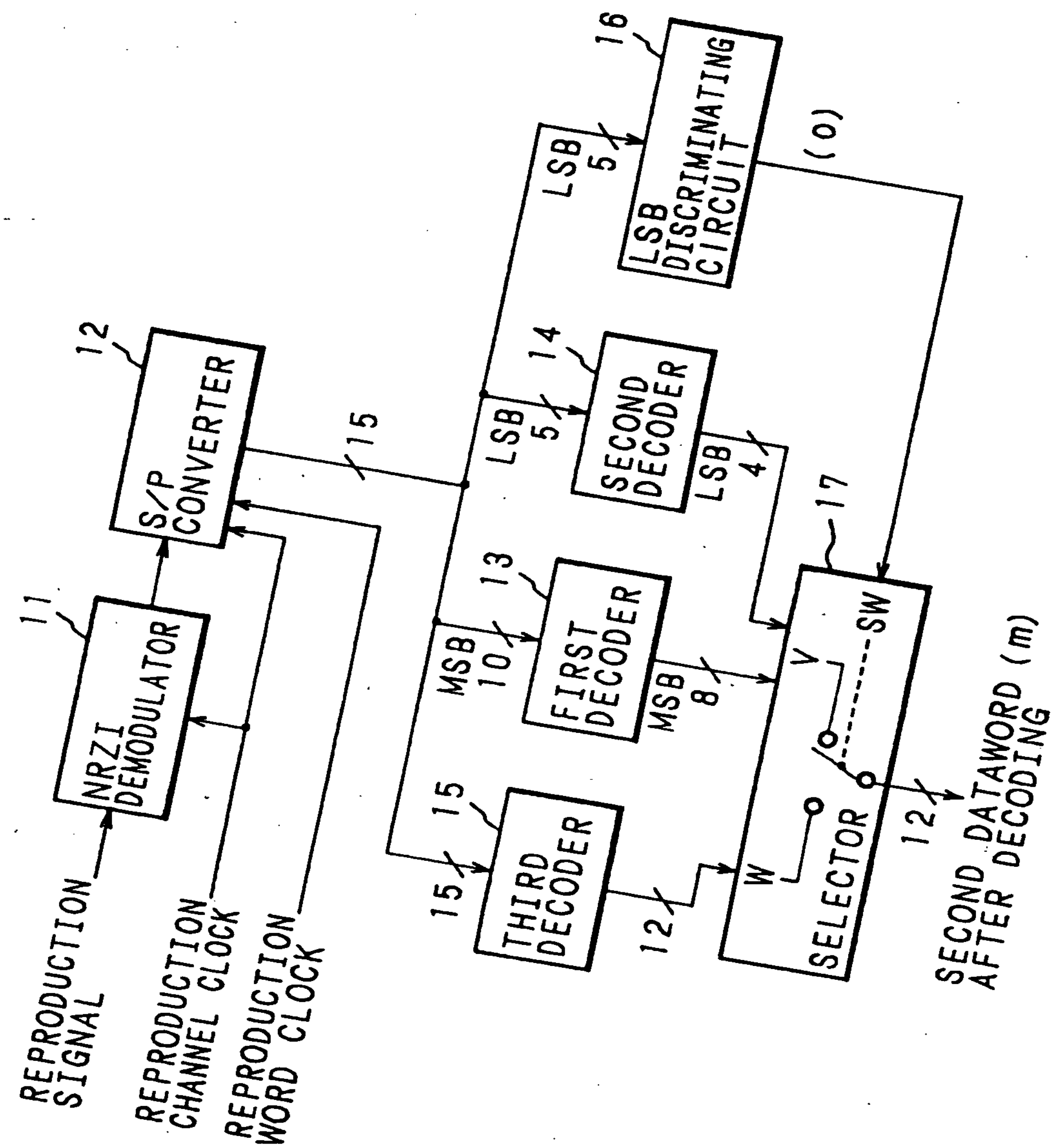

REPRODUCTION SIGNAL
REPRODUCTION CHANNEL CLOCK
REPRODUCTION WORD CLOCK
11
NRZI DEMODULATOR
12
S/P CONVERTER
15
13
FIRST DECODER
14
SECOND DECODER
15
THIRD DECODER
16
LSB DISCRIMINATING CIRCUIT
17
SELECTOR
MSB
10
MSB
8
LSB
5
LSB
4
LSB
5
15
12
(o)
V
W
SW
12
SECOND DATAWORD (m) AFTER DECODING

Fig. 33

n2 GROUP	m2 DATA 0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	07	09	0A	0B	0D	0E	0F	12	15	17	19	1A	1B	1D	1E	1F
2	01		03		05		06									
3											11		13			16
4		11		13		16		11	13	16		11		13	16	

Fig. 34(a)

Q′=0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00	4E7B	4E7E	CEA1	4EA3	4EA6	CEC2	4EC5	CEC7	4ECA	CECD	4ECF	CED9	4EDB	4EDE	CEF1	4EF3
01	4EF6	4F43	4F46	4F85	CF87	4F8A	CF8D	4F8F	CF99	4F9B	4F9E	CFB1	4FB3	4FB6	CFE1	4FE3
02	4FE6	D0B9	50BB	50BE	D092	5095	D097	509A	D09D	509F	50A9	D0AB	D0AE	50B2	D0B5	50B7
03	D0BA	50BD	D0BF	50D1	D0D3	D0D6	50E2	D0E5	50E7	D0EA	50ED	D0EF	50F9	D0FB	D0FB	D011
04	5113	5116	D122	5125	D127	512A	D12D	512F	D139	513B	513E	5149	D14B	D14E	5152	D155
05	5157	D15A	515D	D15F	D169	516B	516E	D172	5175	D177	517A	D17D	517F	5191	D193	D196
06	51A2	D1A5	51A7	D1AA	51AD	D1AF	51B9	D1BB	D1BE	D1C9	51CB	51CE	D1D2	51D5	D1D7	51DA
07	D1DD	51DF	51E9	D1EB	D1EE	51F2	D1F5	51F7	D1FA	51FD	D1FF	D221	5223	5226	D242	5245
08	D247	524A	D24D	524F	D259	525B	525E	D271	5273	5286	5289	D28B	D28E	5292	D295	5297
09	D29A	529D	D29F	D2A9	52AB	52AE	D2B2	52B5	D2B7	52BA	D2BD	52BF	D2D1	52D3	52D6	D2E2
0A	52E5	D2E7	52EA	D2ED	D2EF	D2F9	52FB	52FE	5311	D313	D316	5322	D325	5327	D32A	532D
0B	D32F	5339	D33B	D33E	D349	534B	534E	D352	5355	D357	535A	D35D	535F	5369	D36B	D36E
0C	5372	D375	5377	D37A	537D	D37F	D391	5393	5396	D3A2	53A5	D3A7	53AA	D3AD	53AF	D3B9
0D	53BB	53BE	53C9	D3CB	D3CE	53D2	D3D5	53D7	D3DA	53DD	D3DF	D3E9	53EB	53EE	D3F2	53F5
0E	D3F7	53FA	D3FD	53FF	5443	5446	5485	D487	548A	D48D	548F	D499	549B	549E	D4B1	54B3
0F	54BB	D4E1	54E3	54E6	5509	D50B	D50E	5512	D515	5517	D51A	551D	D51F	D529	552B	552E

Fig. 34(b)

$Q'=0$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
10	D532	5535	D537	553A	D53D	553F	D551	5553	5556	D562	5565	D567	556A	D56D	556F	D579
11	557B	557E	D5A1	55A3	55A6	D542	55C5	D5C7	55CA	D5CD	55CF	D5D9	55DB	55DE	D5F1	55F3
12	55F6	5611	D613	D616	5622	D625	5627	D62A	562D	D62F	5639	D63B	D63E	D649	564B	564E
13	D652	5655	D657	565A	D65D	565F	5669	D66B	D66E	5672	D675	5677	D67A	567D	D67F	D691
14	5693	5696	D6AE	56A5	D6A7	56AA	D6AD	56AF	D6B9	56BB	56BE	56C9	D6CB	D6CE	56D2	D6D5
15	56D7	D6DA	56DD	D6DF	D6E9	56EB	56EE	D6F2	56F5	D6F7	56FA	D6FD	56FF	D621	5623	5626
16	D742	5745	D747	574A	D74D	574F	D759	575B	575E	D771	5773	5776	5789	D78B	D78E	5792
17	D795	5797	D79A	579D	D79F	D7A9	57AB	D7AE	D7B2	57B5	D7B7	57BA	D7BD	57BF	D7D1	57D3
18	57D6	D7E2	57E5	D7E7	57EA	D7ED	57EF	D7F9	57FB	57FE	5886	590A	D90D	590F	D919	591B
19	591E	D931	5933	5936	D961	5963	5966	59C3	59C6	5A12	DA15	5A17	DA1A	5A1D	DA1F	DA29
1A	5A2B	5A2E	DA32	5A35	DA37	5A3A	DA3D	5A3F	DA51	5A53	5A56	DA62	5A65	DA67	5A6A	DA6D
1B	5A6F	DA79	5A7B	5A7E	DAA1	5AA3	5AA6	DAC2	5AC5	DAC7	5ACA	DACD	5ACF	DAD9	5ADB	5ADE
1C	DAF1	5AF3	5AF6	5B43	5B46	5B85	DB87	5B8A	DB8D	5B8F	DB99	5B9B	5B9E	DBB1	5BB3	5BB6
1D	DBE1	5BE3	5BE6	5C22	DC25	5C27	DC2A	5C2D	DC2F	5C39	DC3B	DC3E	DC49	5C4B	5C4E	DC52
1E	5C55	DC57	5C5A	DC5D	5C5F	5C69	DC6B	DC6E	5C72	DC75	5C77	DC7A	5C7D	DC7F	DC91	5C93
1F	5C96	DCA2	5CA5	DCA7	5CAA	DCAD	5CAF	DCB9	5CBB	5CBE	5CC9	DCCB	DCCE	5CD2	DCD5	5CD7

Fig. 35(a)

Q′=0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
20	DCDA	5CDD	DCDF	DCE5	5CEB	5CEE	DCF2	5CF5	DCF7	5CFA	DCFD	5CFF	DD21	5D23	5D26	DD42
21	5D45	DD47	5D4A	DD4D	5D4F	DD59	5D5B	5D5E	DD71	5D73	5D76	5D89	DD8B	DD8E	5D92	DD95
22	5D97	DD9A	5D9D	DD9F	DDA9	5DAB	5DAE	DDB2	5DB5	DDB7	5DBA	DDBD	5DBF	DDD1	5DD3	5DD6
23	DDE2	5DE5	DDE7	5DEA	DDED	5DEF	DDF9	5DFB	5DFE	5E43	5E46	5E85	DE87	5E8A	DE8D	5E8F
24	DE99	5E9B	5E9E	DED1	5ED3	5EB6	DEE1	5EE3	5EE6	5F09	DF0B	DF0E	5F12	DF15	5F17	DF1A
25	5F1D	DF1F	DF29	5F2B	5F2E	DF32	5F35	DF37	5F3A	DF3D	5F3F	DF51	5F53	5F56	DF62	5F65
26	DF67	5F64	DF6D	5F6F	DF79	5F7D	5F7E	DFA1	5FA3	5FA6	DFC2	5FC5	DFC7	5FCA	DFCD	5FCF
27	DFD9	5FDB	5FDE	DFF1	5FF3	5FF6	6843	6846	6885	E887	688A	E88D	688F	E899	689B	689E
28	E8B1	68B7	68B6	E8E1	68E3	68E6	6909	E90B	E90E	6912	E915	6917	E91A	691D	E91F	E929
29	692B	692E	E932	6935	E937	693A	E93D	693F	E951	6953	6956	E962	6965	E967	696A	E96D
2A	696F	E979	697B	697E	E9A1	69A3	69A6	E9C2	69C5	E9C7	69CA	E9CD	69CF	E9D9	69DB	69DE
2B	E9F1	69F3	69F6	6A11	EA13	EA16	6A22	EA25	6A27	EA2A	6A2D	EA2F	6A39	EA3B	EA3E	EA49
2C	6A4B	6A4E	EA52	6A55	EA57	6A5A	EA5D	6A5F	6A66	EA6B	EA6E	6A72	EA75	6A77	EA7A	6A7D
2D	EA7F	EA91	6A93	6A96	EAA2	6AA5	EAA7	6AAA	EAAD	6AAF	EAB9	6ABB	6ABE	6AC9	EACB	EACE
2E	6AD2	EAD5	6AD7	EADA	6ADD	EADF	EAE9	6AEB	6AEE	EAF2	6AF5	EAF7	6AFA	EAFD	6AFF	EB21
2F	6B23	6B26	EB42	6B45	EB47	6B4A	EB4D	6B4F	EB59	6B5B	6B5E	EB71	6B73	6B76	6B89	EB8B

Fig. 35(b)

$Q' = 0$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
30	EBBE	6B92	EB95	6B97	6B9A	6B9D	EB9F	EBA9	6BAB	6BAE	EBB2	6BB5	EBB7	6BBA	EBBD	6BBF
31	EBD1	6BD3	6BD6	EBE2	EBE5	EBE7	6BEA	EBED	6BEF	EBF9	6BFB	6BFE	6C21	EC23	EC26	6C42
32	EC45	6C47	EC4A	6C4D	6C4F	6C59	EC5B	EC5E	6C71	EC73	EC76	EC89	6C8B	6C8E	EC92	6C95
33	EC97	6C9A	EC9D	6C9F	ECA9	ECAB	ECAE	6CB2	ECB5	6CB7	ECBA	6CBD	ECBF	6CD1	ECD3	ECD6
34	6CE2	ECE5	6CE7	ECEA	6CED	ECEF	6CF9	ECFB	ECFE	ED11	6D13	6D16	ED22	6D25	ED27	6D2A
35	ED2D	6D2F	ED39	6D3B	6D3E	6D49	ED4B	ED4E	6D52	ED55	6D57	ED5A	6D5D	ED5F	ED69	6D6B
36	6D6E	ED72	6D75	ED77	6D7A	ED7D	6D7F	6D91	ED93	ED96	6DA2	EDA5	6DA7	EDAA	6DAD	EDAF
37	6DB9	EDBB	EDBE	EDC9	6DCB	6DCE	EDD2	6DD5	EDD7	6DDA	EDDD	6DDF	6DE9	EDEB	EDEE	6DF2
38	EDF5	6DF7	EDFA	6DFD	EDFF	EE21	6E23	6E26	EE42	6E45	EE47	6E4A	EE4D	6E4F	EE59	6E5B
39	6E5E	EE71	6E73	6E76	6E89	EE8B	EE8E	6E92	EE95	6E97	EE95	6E9D	EE9F	EEA9	6EAB	6EAE
3A	EEB2	6EB5	EEB7	6EBA	EEBD	6EBF	EED1	6ED3	6ED6	EEE2	6EEA	EEE7	6EEA	EEED	6EEF	EEF9
3B	6EFB	6EFE	6F11	EF13	EF16	6F22	EF25	6F27	EF2A	6F2D	EF2F	6F39	EF3B	EF3E	EF49	6F4B
3C	6F4E	EF52	6F55	EF57	6F5A	EF5D	6F5F	6F69	EF6B	EF6E	6F72	EF75	6F77	EF7A	6F7D	EF7F
3D	EF91	6F93	6F9B	EFA2	6FA5	EFA7	6FAA	EFAD	6FAF	EFB9	6FBB	6FBE	6FC9	EFCB	EFCE	6FD2
3E	EFD5	6FD7	EFDA	6FDD	EFDF	EFE9	6FEB	6FEE	EFF2	6FF5	EFF7	6FFA	EFFD	6FFF	7086	710A
3F	F10D	710F	F119	711B	711E	F131	7133	7136	F161	7163	7166	71C3	71C6	7212	F215	7217

Fig. 36(a)

Q' = 0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
40	F21A	721D	F21F	F229	722B	722E	F232	7235	F237	723A	F23D	723F	F251	F253	7256	F262
41	7265	F267	726A	F26D	726F	F279	727B	727E	F2A1	72A3	72A6	F2C2	72C5	72C7	72CA	F2CD
42	72CF	F2D9	72DB	72DE	F2F1	72F3	72F6	7343	7346	7385	F387	738A	F38D	738F	F399	739B
43	739E	F381	73B3	73B6	F3E1	73E3	73E6	7422	F425	7427	F42A	742D	F42F	7439	F43B	F43E
44	F449	744B	744E	F452	7455	F457	745A	F45D	745F	7469	F46B	F46E	7472	F475	7477	F47A
45	747D	F47F	F471	7493	7496	F4A2	74A5	F4A7	74AA	F4AD	74AF	F4B9	74BB	74CE	74C9	F4CB
46	F4CE	74D2	F4D5	74D7	F4DA	74DD	F4DF	F4E9	74EB	74EE	F4F2	74F5	F4F7	74FA	F4FD	74FF
47	F521	7523	7526	F542	7545	F547	754A	F54D	754F	F559	755B	755E	F571	7573	7576	7589
48	F58B	F58E	7582	F595	7597	F59A	759D	F59F	F5A9	75AB	75AE	F5B2	75B5	F5B7	75BA	F5BD
49	75BF	F5D1	75D3	75D6	F5E2	75E5	F5E7	75EA	F5ED	75EF	F5F9	75FB	75FE	7643	7646	7685
4A	F687	768A	F68D	768F	F699	769B	769E	F6B1	76B3	76B6	F6E1	76E3	76E6	7709	F70B	F70E
4B	7712	F715	7717	F71A	771D	F71F	F729	772B	772E	F732	7735	F737	773A	F73D	773F	F751
4C	7753	7756	F752	7765	F767	776A	F76D	776F	F776	777B	777E	F7A1	77A3	77C0	F7A2	77C5
4D	F7C7	77CA	F7CD	77CF	F7D9	77DB	77DE	F7F1	77F3	77F6	7842	F845	7847	F84A	784D	F84F
4E	7859	F85B	F85E	7871	F873	F876	F889	788B	788E	F892	7895	F897	789A	F89D	789F	78A9
4F	F8AB	F8AE	78A2	F8B5	78B7	F8BA	78BD	F8BF	78D1	F8D3	F8D6	78E2	F8E5	78E7	F8EA	78ED

Fig. 36(b)

Q′=0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
50	F8EF	78F9	F8FB	F8FE	F911	7913	7916	F922	7925	F927	792A	F92D	792F	F939	793B	793E
51	7949	F94B	F94E	7952	F955	7957	F95A	795D	F95F	F969	796B	796E	F972	7975	F977	797A
52	F97D	797F	7991	F993	F996	79A2	F9A5	79A7	F9AA	79AD	F9AF	79B9	F9BB	F9BB	F9C9	79CB
53	79CE	F9D2	79D5	F9D7	79DA	F9DD	79DF	79E9	F9EB	F9EE	79F2	F9F5	79F7	F9FA	79FD	F9FF
54	FA21	7A23	7A26	FA42	7A45	FA47	7A4A	FA4D	7A4F	FA59	7A5B	7A5E	FA71	7A73	7A76	7A89
55	FA8B	FA8E	7A92	FA95	7A97	FA9A	7A9D	FA9F	FAA9	7AAB	7AAE	FAB2	7AB5	FAB7	7ABA	FABD
56	7ABF	FAD1	7AD3	7AD6	FAE2	7AE5	FAE7	7AEA	FAED	7AEF	FAF9	7AFB	7AFE	7B11	FB13	FB16
57	7B22	FB25	7B27	FB2A	7B2D	FB2F	7B39	FB3B	FB3E	FB49	7B4B	7B4F	FB52	7B55	FB57	7B5A
58	FB5D	7B5F	7B69	FB6B	FB6E	7B72	FB75	7B77	FB7A	7B7D	FB7F	FB91	7B93	7B96	FBA2	7BA5
59	FBA7	7BAA	FBAD	7BAF	FBB9	7BBB	7BBE	7BC9	FBCB	FBCE	7BD2	FBD5	7BD7	FBDA	7BDD	FBDF
5A	FBE9	7BEB	7BEE	FBF2	7BF5	FBF7	7BFA	FBFD	7BFF	7C43	7C46	7C85	FC87	7C8A	FC8D	7C8F
5B	FC99	7C9B	7C9E	FCB1	7CB3	7CB6	FCE1	7CE3	7CE6	7D09	FD0B	FD0E	7D12	FD15	7D17	FD1A
5C	7D1D	FD1F	FD29	7D2B	7D2E	FD32	7D35	FD37	7D3A	FD3D	7D3F	FD51	7D53	7D56	FD62	7D65
5D	FD67	7D6A	FD6D	7D6F	FD79	7D7B	7D7E	FDA1	7DA3	7DA6	FDC2	7DC5	FDC7	7DCA	FDCD	7DCF
5E	FDD9	7DDB	7DDE	FDF1	7DF3	7DF6	7E11	FE13	FE16	7E22	FE25	7E27	FE2A	7E2D	FE2F	7E39
5F	FE3B	FE3E	FE49	7E4B	7E4E	FE52	7E55	FE57	7E5A	FE5D	7E5F	7E69	FE6B	FE6E	7E72	FE75

Fig. 37(a)

$Q' = 0$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
60	7E77	FE7A	7E7D	FE7F	FE91	7E93	7E96	FEA2	7EA5	FEA7	7EAA	FEAD	7EAF	FEB9	7EBB	7EBE
61	7EC9	FECB	FECE	7ED2	FED5	7ED7	FEDA	7EDD	FEDF	FEE9	7EEB	7EEE	FEF2	7EF5	FEF7	7EFA
62	FEFD	7EFF	FF21	7F23	7F26	FF42	7F45	FF47	7F4A	FF4D	7F4F	FF59	7F5B	7F5E	FF71	7F73
63	7F76	7F89	FF8B	FF8E	7F92	FF95	7F97	FF9A	7F9D	FF9F	FFA9	7FAB	7FAE	FFB2	7FB5	FFB7
64	7FBA	FFBD	7FBF	FFD1	7FD3	7FD8	FFE2	7FE5	FFE7	7FEA	FFED	7FEF	FFF9	7FFB	7FFB	8842
65	0845	8847	084A	884D	084F	8859	085B	085E	8871	0873	0876	0889	888B	888E	0892	8895
66	0897	889A	089D	889F	88A9	08AB	08AE	88B2	08B5	88B7	08BA	88BD	08BF	88D1	08D3	08D6
67	88E2	08E5	88E7	08EA	88ED	08EF	88F9	08FB	08FE	0911	8913	8916	0922	8925	0927	892A
68	092D	892F	0939	893B	893E	8949	094B	094E	8952	0955	8957	095A	895D	095F	0969	896B
69	896E	0972	8975	0977	897A	097D	897F	8991	0993	0996	89A2	09A5	89A7	09AA	89AD	09AF
6A	89B9	09BB	09BE	09C9	89CB	89CE	09D2	89D5	09D7	89DA	09DD	89DF	89E9	09EB	09EE	89F2
6B	09F5	89F7	09FA	89FD	09FF	0A21	8A23	8A26	0A42	8A45	0A47	8A4A	0A4D	8A4F	0A59	8A5B
6C	8A5E	0A71	8A73	8A76	8A89	0A8B	0A8E	8A92	0A95	8A97	0A9A	8A9B	0A9F	0AA9	8AAB	8AAE
6D	0AB2	8AB5	0AB7	8ABA	0AB0	8ABF	0AD1	8AD3	8AD6	0AE2	8AE5	0AE7	8AEA	0AED	8AEF	0AF9
6E	8AFB	8AFE	8B11	0B13	0B16	8B22	0B25	8B27	0B2A	8B2D	0B2F	8B39	0B3B	0B3E	0B49	8B4B
6F	8B4E	0B52	8B55	0B57	8B5A	0B5D	8B5F	8B69	0B6B	0B6E	8B72	0B75	8B77	0B7A	8B7D	0B7F

Fig. 37(b)

$Q'=0$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
70	0B91	8B93	8B96	0BA2	8BA5	0BA7	8BAA	0BAD	8BAF	0BB9	8BBB	8BBE	8BC9	0BCB	0BCE	8BD2
71	0BD5	8BD7	0BDA	8BDD	0BDF	0BE9	8BEB	8BEE	0BF2	8BF5	0BF7	8BFA	0BFD	8BFF	8B43	8B46
72	8C85	0C87	8C8A	0CBD	8C8F	0C99	8C9B	8C9E	0CB1	8CB3	8CB6	0CE1	8CE3	8CE6	8C09	0C0B
73	0D0E	8D12	0D15	8D17	0D1A	8D1D	0D1F	0D29	8D2B	8D2E	0D32	8D35	0D37	8D3A	0D3D	8D3F
74	0D51	8D53	8D56	0D62	8D65	0D67	8D6A	0D6D	8D6F	0D79	8D7B	8D7E	0DA1	8DA3	8DA6	0DC2
75	8DC5	0DC7	8DCA	0DCD	8DCF	0DD9	8DDB	8DDE	0DF1	8DF3	8DF6	8E11	0E13	0E16	8E22	0E25
76	8E27	0E2A	8E2D	0E2F	8E39	0E3B	0E3E	0E49	8E4B	8E4E	0E52	8E55	0E57	8E5A	0E5D	8E5F
77	8E69	0E6B	0E6E	8E72	0E75	8E77	0E7A	8E7D	0E7F	0E91	8E93	8E96	0EA2	8EA5	0EA7	8EAA
78	0EAD	8EAF	0EB9	8EBB	8EBE	8EC9	0ECB	0ECE	8ED2	0ED5	8ED7	0EDA	8EDD	0EDF	0EE9	8EEB
79	8EEE	0EF2	8EF5	0EF7	8EFA	0EFD	8EFF	0E21	8F23	8F26	0F42	8F45	0F47	8F4A	0F4D	8F4F
7A	0F59	8F5B	8F5E	0F71	8F73	8F76	8F8B	0F8B	0F8E	8F92	0F95	8F97	0F9A	8F9D	0F9F	0FA9
7B	8FAB	8FAE	0FB2	8FB5	0FB7	8FBA	0FBD	8FBF	0FD1	8FD3	8FD6	0FE2	8FE5	0FE7	8FEA	0FED
7C	8FEF	0FF9	8FFB	8FFE	1085	9087	108A	908D	108F	9099	109B	109E	90B1	10B3	10B6	90E1
7D	10E3	10E6	1109	910B	910E	1112	9115	1117	911A	111D	911F	9129	112B	112E	9132	1135
7E	9137	113A	013D	113F	9151	1153	1156	9162	1165	9167	116A	016D	116F	9179	117B	117E
7F	91A1	11A3	11A6	91C2	11C5	91C7	11CA	91CD	11CF	81D9	11DB	11DE	91F1	11F3	11F6	1211

Fig. 38(a)

Q′=0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
80	9213	9216	1222	0225	1227	922A	122D	022F	1239	923B	923E	9249	124B	124E	9252	1255
81	9257	125A	925D	125F	1269	926B	926E	1272	9275	1277	927A	127D	927F	9291	1293	1296
82	92A2	12A5	92A7	12AA	92AD	12AF	92B0	12BB	12BE	12C9	92CB	92CE	12D2	92D5	12D7	92DA
83	12DD	92DF	92E9	12EB	12EE	92F2	12F5	93F7	12FA	92FD	12FF	9321	1323	1326	9342	1345
84	9347	134A	934D	134F	9359	135B	135E	0371	1373	1376	1389	93BB	938E	1392	9395	1397
85	939A	139D	939F	93A9	13AB	13AE	93B2	13B5	93B7	13BA	938D	13BF	93D1	13D3	13D6	93E2
86	13E5	93E7	13EE	93ED	13EF	93F9	13FB	14FE	1421	0423	9426	1442	9445	1447	944A	144D
87	944F	1459	945D	945E	1471	9473	9476	9489	148B	148E	9492	1495	9497	149A	949D	149F
88	14A9	94AB	94AE	14B2	94B5	14B7	94BA	158D	94BF	14D1	94D3	94D6	14E2	94E5	14E7	94EA
89	14ED	94EF	14F9	94FB	94FE	9511	1513	1516	9522	1525	9527	152A	952D	152F	9539	153B
8A	153E	1549	9548	954E	1552	9555	1557	955A	155D	055F	9569	156B	156E	9572	1575	9577
8B	157A	957D	157F	1591	9593	9596	15A2	95A5	15A7	05AA	15AD	95AF	15B9	95BB	05BE	95C9
8C	15CB	15CE	95D2	15D5	95D7	15DA	95DD	15DF	15A9	05EB	95EE	15F2	95F5	15F7	95FA	15FD
8D	95FF	9621	1623	1626	0642	1645	0647	164A	964D	164F	9659	1658	165E	9671	1673	1676
8E	1689	9688	968E	169E	0695	1697	069A	169D	969F	96A9	16AB	16AE	96B2	16B5	06B7	16BA
8F	96BD	16B4	96D1	16D3	16D6	96E2	16E5	96E7	16EA	96ED	16EF	96F9	16FB	16FE	1711	9713

Fig. 38(b)

$Q' = 0$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
90	9716	1722	9725	1727	972A	172D	972F	1739	973B	973E	9749	174B	174E	9752	1755	9757
91	175A	975D	175F	1769	976B	976E	1772	9775	1777	977A	177D	977F	9791	1793	1796	97A2
92	17A5	97A7	17AA	97AD	17AF	97B9	17BB	17BE	17C9	97CB	97CE	17D2	97D5	17D7	97DA	17DD
93	97DF	97E9	17EB	17EE	97F2	17F5	97F7	17FA	97FD	17FF	9843	98A6	9885	1887	988A	1B8D
94	988F	1899	989B	989E	18B1	98B3	98B6	18E1	98E3	98E6	9909	190B	190E	9912	1915	9917
95	191A	991D	191F	1929	992B	992E	1932	9935	1937	993A	193D	993F	1951	9953	9956	1962
96	9965	1967	996A	196D	996F	1979	997B	997E	19A1	99A3	99A6	19C2	99C5	19C7	99CA	19CD
97	09CF	19D9	99DB	99DE	19F1	99F3	99F6	9A11	1A13	1A16	9A22	1A25	9A27	1A2A	9A2D	1A2F
98	9A39	1A3B	1A3E	1A49	9A4B	9A4E	1A52	9A55	1A57	9A5A	1A5D	9A5F	9A65	1A6B	1A6E	9A72
99	1A75	9A77	1A7A	9A7D	1A7F	1A91	9A93	9A96	1AA2	9AA5	1AA7	9AAA	1AAD	9AAF	1AB9	9ABB
9A	0ABE	9AC9	1ACB	1ACE	0AD2	1AD5	9AD7	1ADA	9ADD	1ADF	1AE9	9AEB	9AEE	1AF2	9AF5	1AF7
9B	0AFA	1AFD	9AFF	1B21	0B23	0B26	1B42	9B45	1B47	0B4A	1B4D	0B4F	1B59	9B5B	0B5E	1B71
9C	0B73	9B76	9B89	1BBB	1B8E	0B92	1B95	9B97	1B9A	0B9D	1B9F	1BA9	8BAB	9BAE	1BB2	9BB5
9D	1BB7	0BBA	1BBD	9BBF	1BD1	0BD3	9BD6	1BE2	9BE5	1BE7	9BEA	1BED	0BEF	1BF9	9BFB	9BFE
9E	9C21	1C23	1C26	9C42	1C45	0C47	1C4A	9C4D	1C4F	0C55	1C5B	1C5E	0C71	1C73	1C76	1C89
9F	0C8B	0C8E	1C92	9C95	1C97	0C9A	1C9D	9C9F	9CA9	1CAB	1CAE	0CB2	1CB5	9CB7	1CBA	9CBD

Fig. 39(a)

$Q' = 0$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
A0	1CBF	9CD1	1CD3	1CD6	9CE2	1CE5	9CE7	1CEA	9CED	1CEF	9CF9	1CFB	1CFE	1D11	9D13	9D16
A1	1D22	9D25	1D27	9D2A	1D2D	9D2F	1D39	9D3B	9D3E	9D49	1D4B	1D4E	9D52	1D55	9D57	1D5A
A2	9D5D	1D5F	1D69	9D6B	9D6E	1D72	9D75	1D77	9D7A	1D7D	9D7F	9D91	1D93	1D96	9DA2	1DA5
A3	9DA7	1DAA	9DAD	1DAF	9DB9	1DBB	1DBE	1DC9	9DCB	9DCE	1DD2	9DD5	1DD7	9DDA	1DDD	9DDF
A4	9DE9	1DEB	1DEE	9DF2	1DF9	9DF7	1DFA	9DFD	1DFF	1E21	9E23	9E26	1E42	9E45	1E47	9E4A
A5	1E4D	9E4F	1E59	9E5B	9E5B	1E71	9E73	9E76	9E89	1E8B	1E8E	9E92	1E95	9E97	1E9A	9E9D
A6	1E9F	1EA9	9EAB	9EAE	1EB2	9EB5	1EB7	9EBA	1EBD	9EBF	1ED1	9ED3	9ED6	1EE2	9EE5	1EE7
A7	9EEA	1EED	9EEF	1EF9	9EFB	9EFE	9F11	1F13	1F16	9F22	1F25	9F27	1F2A	9F2D	1F2F	9F39
A8	1F3B	1F3E	1F49	9F4B	9F4E	1F52	9F55	1F57	9F5A	1F5D	9F5F	9F69	1F6B	1F6E	9F72	1F7D
A9	9F77	1F7A	9F7D	1F7F	1F91	9F93	9F96	1FA2	9FA5	1FA7	9FAA	1FAD	9FAF	1FB9	9FBB	9FBE
AA	9FC9	1FCB	1FCE	9FD2	1FD5	9FD7	1FDA	9FDD	1FDF	1FE9	9FEB	9FEE	1FF2	9FF5	1FF7	9FFA
AB	1FFD	9FFF	210A	A10D	210F	A119	211B	211E	A131	2133	2136	A161	2163	2166	21C3	21C6
AC	2212	A215	2217	A21A	221D	A21F	A229	222B	222E	A232	2235	A237	223A	A23D	223F	A251
AD	2253	2256	A262	2265	A267	226A	A26D	226F	A279	227B	227E	A2A1	22A3	22A6	A2C2	22C5
AE	A2C7	22CA	A2CD	22CF	A2D9	22DB	22DE	A2F1	22F3	22F6	2343	2346	2385	A387	238A	A38D
AF	238F	A399	239B	239E	A3B1	23B3	23B6	A3E1	23E3	23E6	2422	A425	2427	A42A	242D	A42F

Fig. 39(b)

Q′=0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
B0	2439	A43B	A43E	A449	244B	244E	A452	2455	A457	245A	A45D	245F	2469	A46B	A46E	2472
B1	A475	2477	A47A	247D	A47F	A491	2493	2496	A4A2	24A5	A4A7	24AA	A4AD	24AF	A4B9	24BB
B2	24BE	24C9	A4C8	A4CE	24D2	A4D5	24D7	A4DA	24DD	A4DF	A4E9	24EB	24EE	A4F2	24F5	A4F7
B3	24FA	A4FD	24FF	A521	2523	2526	A542	2545	A547	254A	A54D	254F	A555	255B	255E	A571
B4	2573	2576	2589	A58B	A58E	2592	A595	2597	A59A	259D	A59F	A5A9	25AB	25AE	A5B2	25B5
B5	A5B7	25BA	A58D	25BF	A5D1	25D3	25D6	A5E2	25E5	A5E7	25EA	A5ED	25EF	A5F9	25FB	25FE
B6	2643	2646	2685	A687	268A	A68D	268F	A699	269B	269E	A6B1	26B3	26B6	A6E1	26E3	26E6
B7	2709	A70B	A70E	2712	A715	2717	A71A	271D	A71F	A729	272B	272E	A732	2735	A737	273A
B8	A73D	273F	A751	2753	2756	A762	2765	A767	276A	A76D	276F	A779	277B	277E	A7A1	27A3
B9	27A6	A7C2	27C5	A7C7	27CA	A7CD	27CF	A7D9	27DB	27DE	A7F1	27F3	27F6	2842	A845	2847
BA	A84A	284D	A84F	2859	A85B	A85E	2871	A873	A876	A889	288B	288E	A892	2895	A897	289A
BB	A89D	289F	28A9	A8AB	A8AE	28B2	A8B5	28B7	A8BA	28BD	A8BF	28D1	A8D3	A8D6	28E2	A8E5
BC	28E7	A8EA	28ED	A8EF	28F9	A8FB	A8FE	A911	2913	2916	A92E	2925	A927	292A	A92D	292F
BD	A939	293B	293E	2949	A94B	A94E	2952	A955	2957	A95A	295D	A95F	A969	296B	296E	A972
BE	2975	A977	297A	A97D	297F	2991	A993	A996	29A2	A9A5	29A7	A9AA	29AD	A9AF	29B9	A9BB
BF	A9BE	A9C9	29CB	29CE	A9D2	29D5	A9D7	29DA	A9DD	29DF	29E9	A9EB	A9EE	29F2	A9F5	29F7

Fig. 40(a)

Q′=0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
C0	A9FA	29FD	A9FF	AA21	2A23	2A26	AA42	2A45	AA47	2A4A	AA4D	2A4F	AA55	2A5B	2A5E	AA71
C1	2A73	2A76	2A89	AA8B	AA8E	2A92	AA95	2A97	AA9A	2A9D	AA9F	AA99	2AAB	2AAE	AAB2	2AB5
C2	AAB7	2ABA	AABD	2ABF	AAD1	2AD3	2AD0	AAE2	2AE5	AAE7	2AEA	AAAD	2AEF	AAF9	2AFB	2AFE
C3	2B11	AB13	AB16	2B22	AB25	2B27	AB2A	2B2D	AB2F	2B39	AB3B	AB3E	AB49	2B4B	2B4E	AB52
C4	2B55	AB57	2B5A	AB5D	2B5F	2B69	AB6B	AB6E	2B72	AB75	2B77	AB7A	2B7D	AB7F	AB91	2B93
C5	2B96	ABA2	2BA5	ABA7	2BAA	ABAD	2BAF	ABB9	2BBB	2BBE	2BC9	ABCB	ABCE	2BD2	ABD5	2BD7
C6	ABDA	2BDD	ABDF	ABE9	2BEB	2BEE	ABF2	2BF5	ABF7	2BFA	ABFD	2BFF	2C43	2C46	2C85	AC87
C7	2C8A	AC8D	2C8F	AC99	2C9B	2C9E	ACB1	2C83	2CB6	ACE1	2CE3	2CE6	2D09	AD0B	AD0E	2D12
C8	AD15	2D17	AD1A	2D1D	AD1F	AD29	2D2B	2D2E	AD32	2D35	AD37	2D3A	AD3D	2D3F	AD51	2D53
C9	2D56	AD62	2D65	AD67	2D6A	AD6D	2D6F	AD79	2D7B	2D7E	ADA1	2DA3	2DA6	ADC2	2DC5	ADC7
CA	2DCA	ADCD	2DCF	ADD9	2DDB	2DDE	ADF1	2DF3	2DF6	2E11	AE13	AE16	2E22	AE25	2E27	AE2A
CB	2E2D	AE2F	2E39	AE3B	AE3E	AE49	2E4B	2E4E	AE52	2E55	AE57	2E5A	AE5D	2E5F	2E69	AE6B
CC	AE6E	2E72	AE75	2E77	AE7A	2E7D	AE7F	AE91	2E93	2E96	AEA2	2EA5	AEA7	2EAA	AEAD	2EAF
CD	AE89	2EBB	2EBE	2EC9	AECB	AECE	2EB2	AED5	2ED7	AEDA	2EDD	AEDF	AEE9	2EEB	2EEE	AEF2
CE	2EF5	AEF7	2EFA	AEFD	2EFF	AF21	2F23	2F26	AF42	2F45	AF47	2F4A	AF4D	2F4F	AF59	2F5B
CF	2F5E	AF71	2F73	2F76	2F89	AF8B	AF8E	2F92	AF95	2F97	AF9A	2F9D	AF9F	AFA5	2FAB	2FAE

Fig. 40(b)

$Q' = 0$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
D0	AFB2	2FB5	AFB7	2FBA	AFBD	2FBF	AFD1	2FD3	2FD6	AFE2	2FE5	AFE7	2FEA	AFED	2FEF	AFF9
D1	2FFB	2FFE	B085	3087	808A	308D	808F	3099	809B	809E	30B1	80B3	80B6	30E1	80E3	B0E6
D2	B109	310B	310E	8112	3115	8117	311A	811D	311F	3129	812B	812E	3132	B135	3137	813A
D3	313D	813F	3151	8153	8156	3162	8165	3167	816A	316D	816F	3179	817B	B17E	31A1	81A3
D4	81A6	31C2	81C5	31C7	81CA	31CD	81CF	31D9	81DB	81DE	31F1	81F3	81F6	B211	3213	3216
D5	8222	3225	8227	322A	822D	322F	8239	323B	323E	3249	824B	824E	3252	B255	3257	825A
D6	325D	825F	8269	326B	326E	8272	3275	8277	327A	827D	327F	3291	8293	B296	32A2	82A5
D7	32A7	82AA	32AD	82AF	3289	82BB	82BE	82C9	32CB	32CE	82D2	32D5	82D7	32DA	82DD	32DF
D8	32E9	82EB	82EE	32F2	82F5	32F7	82FA	32FD	82FF	3321	8323	8326	3342	B345	3347	834A
D9	334D	834F	3359	835B	835E	3371	8373	8376	8389	338B	338E	8392	3395	8397	339A	839D
DA	339F	33A9	83AB	83AE	33B2	83B5	33B7	83BA	33BD	83BF	33D1	83D3	83D6	33E2	8325	33E7
DB	83EA	33ED	83EF	33F9	83FB	83FE	8421	3423	3426	8442	3445	8447	344A	B44D	344F	8459
DC	345B	345E	8471	3473	3476	3489	848B	848E	3492	8495	3497	849A	349D	B49F	84A9	34AB
DD	34AE	84B2	34B5	84B7	34BA	84BD	34BF	84D1	34D3	34D6	84E2	34E5	84E7	34EA	84ED	34EF
DE	84F9	34FB	34FE	3511	8513	8516	3522	8525	3527	852A	352D	852F	3539	853B	853E	8549
DF	354B	354E	8552	3555	8557	355A	855D	355F	3569	856B	856E	3572	8575	3577	857A	357D

Fig. 41(a)

Q' = 0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
E0	B57F	B591	3593	3596	B5A2	35A5	B5A7	35AA	B5AD	35AF	B5BB	35BB	35BE	35C9	B5CB	B5CE
E1	35D2	B5D5	35D7	B5DA	35DD	B5DF	B5E9	35EB	35EE	B5F2	35F5	B5F7	35FA	B5FD	35FF	3621
E2	B623	B626	3642	B645	3647	B64A	364D	B64F	3659	B65B	B65E	3671	B673	B676	B689	368B
E3	368E	B692	3695	B697	369A	B69D	369F	36A9	B6AB	B6AE	36B2	B6B5	36B7	B6BA	36BD	B6BF
E4	36D1	B6D3	B6D6	36E2	B6B5	36E7	B6EA	36ED	B6EF	36F9	B6FB	B6FE	B711	3713	3716	B722
E5	3725	B727	372A	B72D	372F	B739	373B	373E	3749	B74B	B74E	3752	B755	3757	B75A	375D
E6	B75F	B769	376B	376B	B772	3775	B777	377A	B77D	377F	3791	B793	B796	37A2	B7A5	37A7
E7	B7AA	37AD	B7AF	37B9	B7BB	B7BE	B7C9	37CB	37CE	B7D2	37D5	B7D7	37DA	B7DD	37DF	37D9
E8	B7EB	B7EE	37F2	B7F5	37F7	B7FA	37FD	B7FF	3843	3846	3885	B887	38BA	B88D	388F	B899
E9	389B	389E	B8B1	38B3	38B6	B8E1	38B3	38E6	3909	B90B	B90E	3912	B915	3917	B91A	391D
EA	B91F	B929	392B	392E	B932	3935	B937	393A	B93D	393F	B951	3953	3956	B962	3965	B967
EB	396A	B96D	396F	B979	397B	397E	B9A1	39A3	39A6	B9C2	39C5	B9C7	39CA	B9CD	39CF	39D9
EC	39DB	39DE	B9F1	39F3	39F6	3A11	BA13	BA16	3A22	BA25	3A27	BA2A	3A2D	BA2F	3A39	BA3B
ED	BA32	BA49	3A4B	3A4E	BA52	3A55	BA57	3A5A	BA5D	3A5F	3A69	BA6B	BA6E	3A72	BA75	3A77
EE	BA7A	3A7D	BA7F	BA91	3A93	3A96	BAA2	3AA5	BAA7	3AAA	BAAD	3AAF	BAB9	3ABB	3ABE	3AC9
EF	BACB	BACE	3AD2	BAD5	3AD7	BADA	3ADD	BADF	BAE9	3AEB	3AEE	BAF2	3AF5	BAF7	3AFA	BAFD

Fig. 41(b)

Q′=0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
F0	3AFF	BB21	3B23	3B26	BB42	3B45	BB47	3B4A	BB4D	3B4F	BB59	3B5B	3B5E	BB71	3B73	3B76
F1	3B89	BB8B	BB8E	3B92	BB95	3B97	BB9A	3B9D	BB9F	BBA9	3BAB	3BAE	BBB2	3BB5	BBB7	3BBA
F2	BBBD	3BBF	BBD1	3BD3	3BD6	BBE2	3BE5	BBE7	3BEA	BBED	3BEF	BBF9	3BFB	3BFE	3C21	BC23
F3	BC26	3C42	BC45	3C47	BC4A	3C4D	BC4F	3C59	BC5B	BC53	3C71	BC73	BC76	BC89	3C8B	3C8E
F4	BC92	3C95	BC97	3C9A	BC9D	3C9F	3CA9	BCAB	BCAE	3CB2	BCB5	3CB7	BCBA	3CBD	BCBF	3CD1
F5	BCD3	BCD6	3CE2	BCE5	3CE7	BCDA	3CED	BCEF	3CF9	BCFB	BCFE	BD11	3D13	3D16	BD22	3D25
F6	BD27	3D2A	BD2D	3D2F	BD39	3D3B	3D3B	3D49	BD48	BD4E	3D52	BD55	3D57	BD5A	3D5D	BD5F
F7	BD69	3D6B	3D6E	BD72	3D75	BD77	3D7A	BD7D	3D7F	3D91	BD93	BD96	3DA2	BDA5	3DA7	BDAA
F8	3DAD	BDAF	3DB9	BDBB	BDBE	BDC9	3DCB	3DCE	BDD2	3DD5	BDD7	3DDA	BDDD	3DDF	3DE9	BDEB
F9	BDEE	3DF2	BDF5	3DF7	BDFA	3DFD	BDFF	BE21	3E23	3E26	BE42	3E45	BE47	3E4A	BE4D	3E4F
FA	BE59	3E5B	3E5E	BE71	3E73	3E76	3E89	BE8B	BE8E	3E92	BE95	3E97	BE9A	3E9D	BE9F	BEA9
FB	3EAB	3EAE	BEB2	3E85	BEB7	3EBA	BEBD	3EBF	BED1	3ED3	3ED6	BEE2	3EE5	BEE7	3EEA	BEED
FC	3EEF	BEF9	3EFB	3EFE	3F11	BF13	BF16	3F22	BF25	3F27	BF2A	3F2D	BF2F	3F39	BF3B	BF3E
FD	BF49	3F4B	3F4E	BF52	3F55	BF57	3F5A	BF5D	3F5F	3F69	BF6B	BF6E	3F72	BF75	3F77	BF7A
FE	3F7D	BF7F	BF91	3F93	3F96	BFA2	3FA5	BFA7	3FAA	BFAD	3FAF	BFB9	3FBB	3FBE	3FC9	BFCB
FF	BFCE	3FD2	BFD5	3FD7	BFDA	3FDD	BFDF	BFE9	3FEB	3FEE	BFF2	3FF5	BFF7	3FFA	BFFD	3FFF

Fig. 42(a)

Q$'$=1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00	CCB5	4CB7	CCBA	4CBD	CCBF	4CD1	CCD3	CCD6	4CE2	CCE5	4CE7	CCEA	4CED	CCEF	4CF9	CCFB
01	CCFE	CD11	4D13	4D16	CD22	4D25	CD27	4D2A	CD2D	4D2F	CD39	4D3B	4D3E	4D49	CD4B	CD4E
02	4D52	CD55	4D57	CD5A	4D5D	CD5F	CD69	4D6B	4D66	CD72	4D75	CD77	4D7A	CD7D	4D7F	4D91
03	CD93	CD96	4DA2	CDA5	4DA7	CDAA	4DAD	CDAF	4DB9	CDBB	CDBE	CDC9	4DCB	4DCE	CDD2	4DD5
04	CDD7	4DDA	CDDD	4DDF	4DEB	CDEB	CDEE	4DF2	CDF5	4DF7	CDFA	4DFD	CDFF	CE21	4E23	4E26
05	CE42	4E45	CE47	4E4A	CE4D	4E4F	CE59	4E5B	4E5E	CE71	4E73	4E76	AE89	CE8B	CE8E	4E92
06	CE95	4E97	CE9A	4E9D	CE9F	CEA9	4EAB	4EAE	CEB2	4EB5	CEB7	4EBA	CEBD	4EBF	CED1	4ED3
07	4ED6	CEE2	4EE5	CEE7	4EEA	CEED	4EEF	CEF9	4EFB	4EFE	4F11	CF13	CF16	4F22	CF25	4F27
08	CF2A	4F2D	CF2F	4F39	CF3B	CF3E	CF49	4F4B	4F4E	CF52	4F55	CF57	4F5A	CF5D	4F5F	4F69
09	CF6B	CF6E	4F72	CF75	4F77	CF7A	4F7D	CF7F	CF91	4F93	4F96	CFA2	4FA5	CFA7	4FAA	CFAD
0A	4FAF	CFB9	4FBB	4FBB	4FC9	CFCB	CFCE	4FD2	CFD5	4FD7	CFAA	4FAD	CFDF	CFE9	4FEB	AFEE
0B	CFF2	4FF5	CFF7	4FFA	CFFD	4FFF	5086	510A	D10D	510F	D119	511B	511E	D131	5133	5136
0C	D161	5163	5166	51C3	51C6	5212	D215	5217	D21A	521D	D21F	D229	522B	522E	D232	5235
0D	D237	523A	D23D	523F	D251	5253	5256	D262	5265	D267	526A	D26D	526F	D279	527B	527E
0E	D2A1	52A3	52A6	D2C2	52C5	D2C7	52CA	D2CD	52CF	D2D9	52DB	52DE	D2F1	52F3	52F6	5343
0F	5346	5385	D387	538A	D38D	538F	D399	5396	539E	D3B1	53B3	53B6	D3E1	53E3	53E6	5422

Fig. 42(b)

Q′=1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
10	D425	5427	D42A	542D	D42F	5439	D43B	D43E	D449	544B	544E	D452	5455	D457	545A	D45D
11	545F	5469	D46B	D46E	5472	D475	5477	D47A	547D	D47F	D491	5493	5498	D4A2	54A5	D4A7
12	54AA	D4AD	54AF	D4B9	54BB	54BE	54C9	D4CB	D4CE	54D2	D4D5	54D7	D4DA	54DD	D4DF	D4E9
13	54EB	54EE	D4F2	54F5	D4F7	54FA	D4FD	54FF	D521	5523	5526	D542	5545	D547	554A	D54D
14	554F	D559	555B	555E	D571	5573	5576	5589	D58B	D58E	5592	D595	5597	D59A	559D	D59F
15	D5A9	55AB	55AE	D5B2	55B5	D5B7	55BA	D5BD	558F	D5D1	55D3	55D6	D5E2	55E5	D5E7	55EA
16	D5ED	55EF	D5F9	55FB	55FE	5643	5646	5685	D687	568A	D68D	568F	D699	569B	569E	D6B1
17	56B3	56B8	D6E1	56E3	56E6	5709	D70B	D70E	5712	D715	5717	D71A	571D	D71F	D729	572B
18	572E	D732	5735	D737	573A	D73D	573F	D751	5753	5756	D762	5765	D767	576A	D76D	576F
19	D779	5778	577E	D7A1	57A3	57A6	D7C2	57C5	D7C7	57CA	D7CD	57CF	D7D9	57DB	57DE	D7F1
1A	57F3	57F6	5842	D845	5847	D84A	584D	D84F	5859	D85B	D85E	5871	D873	D876	D889	588B
1B	588E	D892	5895	D897	589A	D89D	589F	58A9	D8AB	D8AE	58B2	D8B5	5887	D8BA	58BD	D8BF
1C	58D1	D8D3	D8D6	58E2	D8E5	58E7	D8EA	58ED	D8EF	58F9	D8FB	D8FE	D911	5913	5916	D922
1D	5925	D927	592A	D92D	592F	D939	593B	593E	5949	D94B	D94E	5952	D955	5957	D95A	595D
1E	D95F	D969	596B	596E	D972	5975	D977	597A	D97D	597F	5991	D993	D996	59A2	D9A5	59A7
1F	D9AA	59AD	D9AF	59B9	D9BB	D9BE	D9C9	59CB	59CE	D9D2	59D5	D9D7	59DA	D9DD	59DF	59E9

F i g. 43(a)

Q′=1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
20	D9EB	D9EE	59F2	D9F5	59F7	D9FA	59FD	D9FF	DA21	5A23	5A26	DA42	5A45	DA47	5A4A	DA4D
21	5A4F	DA59	5A5B	5A5E	DA71	5A73	5A76	5A89	DA8B	DA8E	5A92	DA95	5A97	DA9A	5A9D	DA9F
22	DAA9	5AAB	5AAE	DAB2	5AB5	DAB7	5ABA	DABD	5ABF	DAD1	5AD3	5ADD	DAE2	5AE5	DAE7	5AEA
23	DAED	5AEF	DAF9	5AFB	5AFE	5B11	DB13	DB16	5B22	DB25	5B27	DB2A	5B2D	DB2F	5B39	DB3B
24	DB3E	DB49	5B4B	5B4E	DB52	5B55	DB57	5B5A	DB5D	5B5F	5B69	DB6B	DB6E	5B72	DB75	5B77
25	DB7A	5B7D	DB7F	DB91	5B93	5B96	DBA2	5BA5	DBA7	5BAA	DBAD	5BAF	DBB9	5BBB	5BBE	5BC9
26	DBCB	DBCE	5BD2	DBD5	5BD7	DBDA	5BDD	DBDF	DBE9	5BE8	5BEE	DBF2	5BF5	DBF7	5BFA	DBFD
27	5BFF	5C43	5C46	5C85	DC87	5C8A	DCBD	5C8F	DC99	5C9B	5C9E	DCB1	5CB3	5CB6	DCE1	5CE3
28	5CE6	5D09	DD0B	DD0E	5D12	DD15	5D17	DD1A	5D1D	DD1F	DD29	5D2B	5D2E	DD32	5D35	DD37
29	5D3A	DD3D	5D3F	DD51	5D53	5D56	DD62	5D65	DD67	5D6A	DD6D	5D6F	DD79	5D7B	5D7E	DDA1
2A	5DA3	5DA6	DDC2	5DC5	DDC7	5DCA	DDCD	5DCF	DDD9	5DDB	5DDE	DDF1	5DF3	5DF6	5E11	DE13
2B	DE16	5E22	DE25	5E27	DE2A	5E2D	DE2F	5E39	DE3B	DE3E	DE49	5E4B	5E4E	DE52	5E55	DE57
2C	5E5A	DE5D	5E5F	5E69	DE6B	DE6E	5E72	DE75	5E77	DE7A	5E7D	DE7F	DE91	5E93	5E96	DEA2
2D	5EA5	DEA7	5EAA	DEAD	5EAF	DEB9	5EBB	5EBE	5EC9	DECB	DECE	5ED2	DED5	5ED7	DEDA	5EDD
2E	DEDF	DEE9	5EEB	5EEE	DEF2	5EF5	DEF7	5EFA	DEFD	5EFF	DF21	5F23	5F26	DF42	5F45	DF47
2F	5F4A	DF4D	5F4F	DF59	5F5B	5F5E	DF71	5F73	5F76	5F89	DF8B	DF8E	5F92	DF95	5F97	DF9A

Fig. 43(b)

Q′=1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
30	5F9D	DF9F	DFA9	5FAB	5FAE	DFB2	5FB5	DF67	5F6A	DFBD	5FBF	DFD1	5FD3	5FD6	DFE2	5FE5
31	DFE7	5FEA	DFED	5FEF	DFF9	5FFB	5FFE	E849	684B	684E	E852	6855	E857	685A	E85D	685F
32	6869	E86B	E86E	6872	E875	6877	E87A	687D	E87F	E891	6893	6896	E8A2	68A5	E8A7	68AA
33	E8AD	68AF	E8B9	68BB	68BE	68C9	E8CB	E8CE	68D2	E8D5	68D7	E8DA	68DD	E8DF	E8E9	68EB
34	68EE	E8F2	68F5	E8F7	68FA	E8FD	68FF	E921	6923	6926	E942	6945	E947	694A	E94D	694F
35	E959	695B	698E	E971	6973	6976	6989	E98B	E98E	6992	E995	6997	E99A	699D	E99F	E9A9
36	69AB	69AE	E9B2	69B5	E9B7	69BA	E9BD	69BF	E9D1	69D3	69D6	E9E2	69E5	E9E7	69EA	E9ED
37	695F	E9F9	69FB	69FE	6A43	6A46	6A85	EA87	6A8A	EA8D	6A8F	EA99	6A9B	6A9E	EAB1	6AD3
38	6AB6	EAE1	6AE3	6AE6	6B09	EB0B	EB0E	6B12	EB15	6B17	EB1A	6B1D	EB1F	EB29	6B2B	6B2E
39	EB32	6B35	EB37	6B3A	EB3D	6B3F	EB51	6B53	6B56	EB62	6B65	EB67	6B6A	EB6D	6B6F	EB79
3A	6B7B	6B7E	EBA1	6BA3	6BA6	EBC2	6BC5	EBC7	6BCA	EBCD	6BCF	EBD9	6BDB	6BDE	EBF1	6BF3
3B	6BF6	6C86	6D0A	ED0D	6D0F	ED19	6D1B	6D1E	ED31	6D33	6D36	ED61	6D63	6D66	6DC3	6DC6
3C	6E12	EE15	6E17	EE1A	6E1D	EE1F	EE29	6E2B	6E2E	EE32	6E35	EE37	6E3A	EE3D	6E3F	EE51
3D	6E53	6E56	EE62	6E65	EE67	6E6A	EE6D	6E6F	EE79	6E7B	6E7E	EEA1	6EA3	6EA6	EEC2	6EC5
3E	EEC7	6ECA	EECD	6ECF	EED9	6EDB	6EDE	EEF1	6EF3	6EF6	6F43	6F46	6F85	EF87	6F8A	EF8D
3F	6F8F	EF99	6F9B	6F9E	EFB1	6FB3	6FB6	EFE1	6FE3	6FE6	F089	708B	708E	F092	7095	F097

F I g. 44(a)

Q′=1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
40	709A	F09D	709F	70A9	F0AB	F0AE	70B2	F0B5	70B7	F0BA	70BD	F0BF	70D1	F0D3	F0D6	70E2
41	F0E5	70E7	F0EA	70ED	F0EF	70F9	F0FD	F0FE	F111	7113	7116	F122	7125	F127	712A	F12D
42	712F	F139	713B	713E	7149	F14B	F14E	7152	F155	7157	F15A	715D	F15F	F169	716B	716E
43	F172	7175	F177	717A	F17D	717F	7191	F193	F196	71A2	F1A5	71A7	F1AA	71AD	F1AF	71B9
44	F1BB	F1BE	F1C9	71CB	71CE	F1D2	71D5	F1D7	71DA	F1DD	71DF	71E9	F1EB	F1EE	71F2	F1F5
45	71F7	F1FA	71FD	F1FF	F221	7223	7226	F242	7245	F247	724A	F24D	724F	F259	725B	725E
46	F271	7273	7276	7289	F28B	F28E	7292	F295	7297	F29A	729D	F29F	F2A9	72AB	72AE	F2B2
47	72B5	F2B7	72BA	F2BD	72BF	F2D1	72D3	72D6	F2E2	72E5	F2E7	72EA	F2ED	72EF	F2F9	72FB
48	72FE	7311	F313	F316	7322	F325	7327	F32A	732D	F32F	7339	F33B	F33E	F349	734B	734E
49	F352	7355	F357	735A	F35D	735F	7369	F36B	F36E	7372	F375	7377	F37A	737D	F37F	F391
4A	7393	7396	F3A2	73A5	F3A7	73AA	F3AD	73AF	F389	73BB	73BE	73C9	F3CB	F3CE	73D2	F3D5
4B	73D7	F3DA	73DD	F3DF	F3E9	73EB	73EE	F3F2	73F5	F3F7	73FA	F3FD	73FF	7443	7446	7485
4C	F487	748A	F4BD	748F	F499	749B	749E	F4B1	74B3	74B6	F4E1	74E3	74E6	7509	F50B	F50E
4D	7512	F515	7517	F51A	751D	F51F	F529	7522	752A	F532	7535	F537	753A	F53D	753F	F551
4E	7553	7556	F562	7565	F567	756A	F56D	756F	F579	757B	757E	F5A1	75A3	75A6	F5C2	75C5
4F	F5C7	75CA	F5CD	75CF	F5D9	75DB	75DE	F5F1	75F3	75F6	7611	F613	F616	7622	F625	7627

Fig. 44(b)

Q' = 1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
50	F62A	762D	F62F	7639	F63B	F63E	F649	764B	764E	F652	7655	F657	765A	F65D	765F	7669
51	F66B	F66E	7672	F675	7677	F67A	767D	F67F	F691	7693	7696	F6A2	76A5	F6A7	76AA	F6AD
52	76AF	F6B9	76BB	76BE	76C9	F6CB	F6CE	76D2	F6D5	76D7	F6DA	76DD	F6DF	F6E9	76EB	76EE
53	F6F2	76F5	F6F7	76FA	F6FD	76FF	F721	7723	7726	F742	7745	F747	774A	F74D	774F	F759
54	775B	775E	F771	7773	7776	7789	F78B	F78E	7792	F795	7797	F79A	779D	F79F	F7A9	77AB
55	77AE	F7B2	77B5	F7B7	77BA	F7BD	77BF	F7D1	77D3	77D6	F7E2	77E5	F7E7	77EA	F7ED	77EF
56	F7F9	77FB	77FE	7886	790A	F90D	790F	F915	791B	791E	F931	7933	7936	F961	7963	7966
57	79C3	79C6	7A12	FA15	7A17	FA1A	7A1D	FA1F	FA29	7A2B	7A2E	FA32	7A35	FA37	7A3A	FA3D
58	7A3F	FA51	7A53	7A56	FA62	7A65	FA67	7A6A	FA6D	7A6F	FA79	7A7B	7A7E	FAA1	7AA3	7AA6
59	FAC2	7AC5	FAC7	7ACA	FACD	7ACF	FAD9	7ADB	7ADE	FAF1	7AF3	7AF6	7B43	7B46	7B85	FB87
5A	7BBA	FB8D	7B8F	FB99	7B9B	7B9E	FBB1	7BB3	7BB6	FBE1	7BE3	7BE6	7C22	FC25	7C27	FC2A
5B	7C2D	FC2F	7C39	FC3B	FC3E	FC49	7C4B	7C4E	FC52	7C55	FC57	7C5A	FC5D	7C5F	7C69	FC6B
5C	FC6E	7C72	FC75	7C77	FC7A	7C7D	FC7F	FC91	7C93	7C96	FCA2	7CA5	FCA7	7CAA	FCAD	7CAF
5D	FCB9	7CBB	7CBE	7CC9	FCCB	FCCE	7CD2	FCD5	7CD7	FCDA	7CDD	FCDF	FCE9	7CEB	7CEE	FCF2
5E	7CF5	FCF7	7CFA	FCFD	7CFF	FD21	7D23	7D26	FD42	7D45	FD47	7D4A	FD4D	7D4F	FD59	7D5B
5F	7D5E	FD71	7D73	7D76	7D89	FD8B	FD8E	7D92	FD95	7D97	FD9A	7D9D	FD9F	FDA9	7DAB	7DAE

Fig. 45(a)

$Q' = 1$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
60	FDB2	7DB5	FDB7	7DBA	FDBD	7DBF	FDD1	7DD3	7DD6	FDE2	7DE5	FDE7	7DEA	FDED	7DEF	FDF9
61	7DFB	7DFE	7E43	7E46	7E85	FE87	7E8A	FE8D	7E8F	FE99	7E9B	7E9E	FEB1	7EB3	7EB6	FEE1
62	7EE3	7EE6	7F09	FF0B	FF0E	7F12	FF15	7F17	FF1A	7F1D	FF1F	FF29	7F2B	7F2E	FF32	7F35
63	FF37	7F3A	FF3D	7F3F	FF51	7F53	7F56	FF62	7F65	FF67	7F6A	FF6D	7F6F	FF79	7F7B	7F7E
64	FFA1	7FA3	7FA6	FFC2	7FC5	FFC7	7FCA	FFCD	7FCF	FFD9	7FDB	7FDE	FFF1	7FF3	7FF6	0842
65	8845	0847	884A	084D	884F	0859	885B	885E	0871	8873	8876	8889	088B	088E	8892	0895
66	8897	089A	889D	089F	08A9	88AB	88AE	08B2	88B5	08B7	88BA	08BD	88BF	08D1	88D3	88D6
67	08E2	88E5	08E7	88EA	08ED	88EF	08F9	88FB	88FE	8911	0913	0916	8922	0925	8927	092A
68	892D	092F	8939	093B	093E	0949	894B	894E	0952	8955	0957	895A	095D	895F	8969	096B
69	096E	8972	0975	8977	097A	897D	097F	0991	8993	8996	09A2	89A5	09A7	89AA	09AD	89AF
6A	09B9	99BB	89BB	89C9	09CB	09CE	89D2	09D5	89D7	09DA	89DD	09DF	09E9	89EB	89EE	09F2
6B	89F5	09F7	89FA	09FD	89FF	8A21	0A23	0A26	8A42	0A45	8A47	0A4A	8A4D	0A4F	8A59	0A5B
6C	0A5E	8A71	0A73	0A76	0A89	8A8B	8A8E	0A92	8A95	0A97	8A9A	0A9D	8A9F	8AA9	0AA2	0AAE
6D	8AB2	0AB5	8AB7	0ABA	8ABD	0ABF	8AD1	0AD3	0AD6	8AE2	0AE5	8AE7	0AEA	8AED	0AEF	8AF9
6E	0AFB	0AFE	0B11	8B13	8B16	0B22	8B25	0B27	8B2A	0B2D	8B2F	0B39	8B3B	8B3E	8B49	0B4B
6F	0B4E	8B52	0B55	8B57	0B5A	8B5D	0B5F	0B69	8B6B	8B6E	0B72	8B75	0B77	8B7A	0B7D	8B7F

Fig. 45(b)

Q′=1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
70	8B91	0B93	0B96	8BA2	0BA5	8BA7	0BAA	8BAD	0BAF	8BB9	0BBB	0BBE	0BC9	8BCB	8BCE	0BD2
71	8BD5	0BD7	8BDA	0BDD	8BDF	8BE9	0BEB	0BEE	8BF2	0BF5	8BF7	0BFA	8BFD	0BFF	0B43	0B46
72	0C85	8C87	0C8A	8CBD	0C8F	8C99	0C9B	0C9E	8CB1	0CB3	0CB6	8CE1	0CE3	0CE6	0C09	8C0B
73	8D0E	0D12	8D15	0D17	8D1A	0D1D	9D1F	8D29	0D2B	0D2E	8D32	0D35	8D37	0D3A	8D3D	0D3F
74	8D51	0D53	0D56	8D62	0D65	8D67	0D6A	8D6D	0D6F	8D79	0D7B	0D7E	8DA1	0DA3	0DA6	8DC2
75	0DC5	8DC7	0DCA	8DCD	0DCF	8DD9	0DDB	0DDE	8DF1	0DF3	0DF6	0E11	8E13	8E16	0E22	8E25
76	0E27	8E2A	0E2D	8E2F	0E39	8E3B	8E3E	8E49	0E4B	0E4E	8E52	0E55	8E57	0E5A	8E5D	0E5F
77	0E69	8E6B	8E6E	0E72	8E75	0E77	8E7A	0E7D	8E7F	8E91	0E93	0E96	8EA2	0EA5	8EA7	0EAA
78	8EAD	0EAF	8EB9	0EBB	0EBE	0EC9	8ECB	8ECE	0ED2	8ED5	0ED7	8EDA	0EDD	8EDF	8EE9	0EEB
79	0EEE	8EF2	0EF5	8EF7	0EFA	8EFD	0EFF	8E21	0F23	0F26	8F42	0F45	8F47	0F4A	8F4D	0F4F
7A	8F59	0F5B	0F5E	8F71	0F73	0F76	0F8B	8F8B	8F8E	0F92	8F95	0F97	8F9A	0F9D	8F9F	8FA9
7B	0FAB	0FAE	8FB2	0FB5	8FB7	0FBA	8FBD	0FBF	8FD1	0FD3	0FD6	8FE2	0FE5	8FE7	0FEA	8FED
7C	0FEF	8FF9	0FFB	0FFE	9085	1087	908A	108D	908F	1099	909B	909E	10B1	90B3	90B6	10E1
7D	90E3	90E6	9109	110B	110E	9112	1115	9117	111A	911D	111F	1129	912B	912E	1132	9135
7E	1137	913A	113D	913F	1151	9153	9156	1162	9165	1167	916A	116D	916F	1179	917B	917E
7F	11A1	91A3	81A6	11C2	91C5	11C7	91CA	11CD	91CF	11D9	91DB	91DE	11F1	91F3	91F6	9211

F I g. 46 (a)

Q′ = 1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
80	1213	1216	9222	1225	9227	122A	922D	122F	9239	123B	123E	1249	924B	924E	1252	9255
81	1257	925A	125D	925F	9269	126B	126E	9272	1275	9277	127A	927D	127F	1291	9293	9296
82	12A2	92A5	12A7	92AA	12AD	92AF	12B0	92BB	92BE	92C9	12CB	12CE	92D2	12D5	92D7	12DA
83	92DD	12DF	12E9	92EB	92EE	12F2	92F5	13F7	92FA	12FD	92FF	1321	9323	9326	1342	9345
84	1347	934A	134D	934F	1359	935B	935E	1371	9373	9376	9389	13BB	138E	9392	1395	9397
85	139A	939D	139F	13A9	93AB	93AE	13B2	93B5	13B7	93BA	138D	93BF	13D1	93D3	93D6	13E2
86	93E5	13E7	93EE	13ED	93EF	13F9	93FB	94FE	9421	1423	1426	9442	1445	9447	144A	944D
87	144F	9459	145D	145E	9471	1473	1476	1489	948B	948E	1492	9495	1497	949A	149D	949F
88	94A9	14AB	14AE	94B2	14B5	94B7	14BA	958D	14BF	94D1	14D3	14D6	94E2	14E5	94E7	14EA
89	94ED	14EF	94F9	14FB	14FE	1511	9513	9516	1522	9525	1527	952A	152D	952F	1539	953B
8A	953E	9549	1548	154E	9552	1555	9557	155A	955D	155F	1569	956B	956E	1572	9575	1577
8B	957A	157D	957F	9591	1593	1596	95A2	15A5	95A7	15AA	95AD	15AF	95B9	15BB	15BE	15C9
8C	95CB	95CE	15D2	95D5	15D7	95DA	15DD	95DF	95A9	15EB	15EE	95F2	15F5	95F7	15FA	95FD
8D	15FF	1621	9623	9626	1642	9645	1647	964A	164D	964F	1659	9658	965E	1671	9673	9676
8E	9689	1688	168E	969E	1695	9697	169A	969D	169F	16A9	96AB	96AE	16B2	96B5	16B7	96BA
8F	16BD	96B4	16D1	96D3	96D6	16E2	96E5	16E7	96EA	16ED	96EF	16F9	96FB	96FE	9711	1713

Fig. 46(b)

Q' = 1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
90	1716	9722	1725	9727	172A	972D	172F	9739	173B	173E	1749	974B	974E	1752	9755	1757
91	975A	175D	975F	9769	176B	176E	9772	1775	9777	177A	977D	177F	1791	9793	9796	17A2
92	97A5	17A7	97AA	17AD	97AF	17B9	97BB	97BE	97C9	17CB	17CE	97D2	17D5	97D7	17DA	97DD
93	17DF	17E9	97EB	97EE	17F2	97F5	17F7	97FA	17FD	97FF	1843	18A6	1885	9887	188A	9B8D
94	188F	9899	189B	189E	98B1	18B3	18B6	98E1	18E3	18E6	1909	990B	990E	1912	9915	1917
95	991A	191D	991F	9929	192B	192E	9932	1935	9937	193A	993D	193F	9951	1953	1956	9962
96	1965	9967	196A	996D	196F	9979	197B	197E	99A1	19A3	19A6	99C2	19C5	99C7	19CA	99CD
97	19CF	99D9	19DB	19DE	99F1	19F3	19F6	1A11	9A13	9A16	1A22	9A25	1A27	9A2A	1A2D	9A2F
98	1A39	9A3B	9A3E	9A49	1A4B	1A4E	9A52	1A55	9A57	1A5A	9A5D	1A5F	1A65	9A6B	9A6E	1A72
99	9A75	1A77	9A7A	1A7D	9A7F	9A91	1A93	1A96	9AA2	1AA5	9AA7	1AAA	9AAD	1AAF	9AB9	1ABB
9A	1ABE	1AC9	9ACB	9ACE	1AD2	9AD5	1AD7	9ADA	1ADD	9ADF	9AE9	1AEB	1AEE	9AF2	1AF5	9AF7
9B	1AFA	9AFD	1AFF	9B21	1B23	1B26	9B42	1B45	9B47	1B4A	9B4D	1B4F	9B59	1B5B	1B5E	9B71
9C	1B73	1B76	1B89	9BBB	9B8E	1B92	9B95	1B97	9B9A	1B9D	9B9F	9BA9	1BAB	1BAE	9BB2	1BB5
9D	9BB7	1BBA	9BBD	1BBF	9BD1	1BD3	1BD6	9BE2	1BE5	9BE7	1BEA	9BED	1BEF	9BF9	1BFB	1BFE
9E	1C21	9C23	9C26	1C42	9C45	1C47	9C4A	1C4D	9C4F	1C55	9C5B	9C5E	1C71	9C73	9C76	9C89
9F	1C8B	1C8E	9C92	1C95	9C97	1C9A	9C9D	1C9F	1CA9	9CAB	9CAE	1CB2	9CB5	1CB7	9CBA	1CBD

Fig. 47(a)

$Q' = 1$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
A0	9CBF	1CD1	9CD3	9CD6	1CE2	9CE5	1CE7	9CEA	1CED	9CEF	1CF9	9CFB	9CFE	9D11	1D13	1D16
A1	9D22	1D25	9D27	1D2A	9D2D	1D2F	9D39	1D3B	1D3E	1D49	9D4B	9D4E	1D52	9D55	1D57	9D5A
A2	1D5D	9D5F	9D69	1D6B	1D6E	9D72	1D75	9D77	1D7A	9D7D	1D7F	1D91	9D93	9D96	1DA2	9DA5
A3	1DA7	9DAA	1DAD	9DAF	1DB9	9DBB	9DBE	9DC9	1DCB	1DCE	9DD2	1DD5	9DD7	1DDA	9DDD	1DDF
A4	1DE9	9DEB	9DEE	1DF2	9DF9	1DF7	9DFA	1DFD	9DFF	9E21	1E23	1E26	9E42	1E45	9E47	1E4A
A5	9E4D	1E4F	9E59	1E5B	1E5B	9E71	1E73	1E76	1E89	9E8B	9E8E	1E92	9E95	1E97	9E9A	1E9D
A6	9E9F	9EA9	1EAB	1EAE	9EB2	1EB5	9EB7	1EBA	9EBD	1EBF	9ED1	1ED3	1ED6	9EE2	1EE5	9EE7
A7	1EEA	9EED	1EEF	9EF9	1EFB	1EFE	1F11	9F13	9F16	1F22	9F25	1F27	9F2A	1F2D	9F2F	1F39
A8	9F3B	9F3E	9F49	1F4B	1F4E	9F52	1F55	9F57	1F5A	9F5D	1F5F	1F69	9F6B	9F6E	1F72	9F7D
A9	1F77	9F7A	1F7D	9F7F	9F91	1F93	1F96	9FA2	1FA5	9FA7	1FAA	9FAD	1FAF	9FB9	1FBB	1FBE
AA	1FC9	9FCB	9FCE	1FD2	9FD5	1FD7	9FDA	1FDD	9FDF	9FE9	1FEB	1FEE	9FF2	1FF5	9FF7	1FFA
AB	9FFD	1FFF	A10A	210D	A10F	2119	A11B	A11E	2131	A133	A136	2161	A163	A166	A1C3	A1C6
AC	A212	2215	A217	221A	A21D	221F	2229	A22B	A22E	2232	A235	2237	A23A	223D	A23F	2251
AD	A253	A256	2262	A265	2267	A26A	226D	A26F	2279	A27B	A27E	22A1	A2A3	A2A6	22C2	A2C5
AE	22C7	A2CA	22CD	A2CF	22D9	A2DB	A2DE	22F1	A2F3	A2F6	A343	A346	A385	2387	A38A	238D
AF	A38F	2399	A39B	A39E	23B1	A3B3	A3B6	23E1	A3E3	A3E6	A422	2425	A427	242A	A42D	242F

Fig. 47(b)

Q' = 1

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
B0	A439	243B	243E	2449	A44B	A44E	2452	A455	2457	A45A	245D	A45F	A469	246B	246E	A472
B1	2475	A477	247A	A47D	247F	2491	A493	A496	24A2	A4A5	24A7	A4AA	24AD	A4AF	24B9	A4BB
B2	A4BE	A4C9	24C8	24CE	A4D2	24D5	A4D7	24DA	A4DD	24DF	24E9	A4EB	A4EE	24F2	A4F5	24F7
B3	A4FA	24FD	A4FF	2521	A523	A526	2542	A545	2547	A54A	254D	A54F	2555	A55B	A55E	2571
B4	A573	A576	A589	258B	258E	A592	2595	A597	259A	A59D	259F	25A9	A5AB	A5AE	25B2	A5B5
B5	25B7	A5BA	258D	A5BF	25D1	A5D3	A5D6	25E2	A5E5	25E7	A5EA	25ED	A5EF	25F9	A5FB	A5FE
B6	A643	A646	A685	2687	A68A	268D	A68F	2699	A69B	A69E	26B1	A6B3	A6B6	26E1	A6E3	A6E6
B7	A709	270B	270E	A712	2715	A717	271A	A71D	271F	2729	A72B	A72E	2732	A735	2737	A73A
B8	273D	A73F	2751	A753	A756	2762	A765	2767	A76A	276D	A76F	2779	A77B	A77E	27A1	A7A3
B9	A7A6	27C2	A7C5	27C7	A7CA	27CD	A7CF	27D9	A7DB	A7DE	27F1	A7F3	A7F6	A842	2845	A847
BA	284A	A84D	284F	A859	285B	285E	A871	2873	2876	2889	A88B	A88E	2892	A895	2897	A89A
BB	289D	A89F	A8A9	28AB	28AE	A8B2	28B5	A8B7	28BA	A8BD	28BF	A8D1	28D3	28D6	A8E2	28E5
BC	A8E7	28EA	A8ED	28EF	A8F9	28FB	28FE	2911	A913	A916	292E	A925	2927	A92A	292D	A92F
BD	2939	A93B	A93E	A949	294B	294E	A952	2955	A957	295A	A95D	295F	2969	A96B	A96E	2972
BE	A975	2977	A97A	297D	A97F	A991	2993	2996	A9A2	29A5	A9A7	29AA	A9AD	29AF	A9B9	29BB
BF	29BE	29C9	A9CB	A9CE	29D2	A9D5	29D7	A9DA	29DD	A9DF	A9E9	29EB	29EE	A9F2	29F5	A9F7

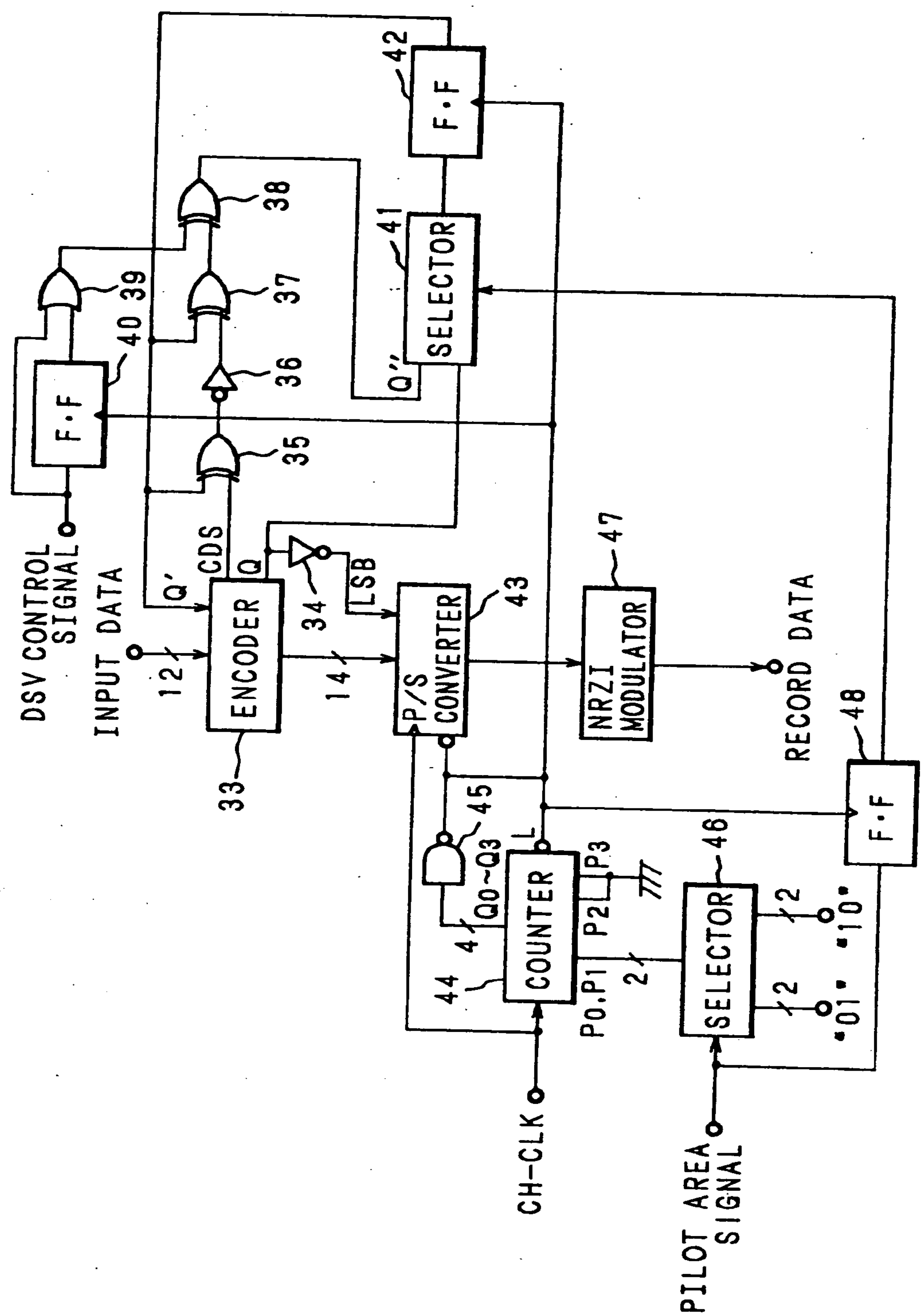
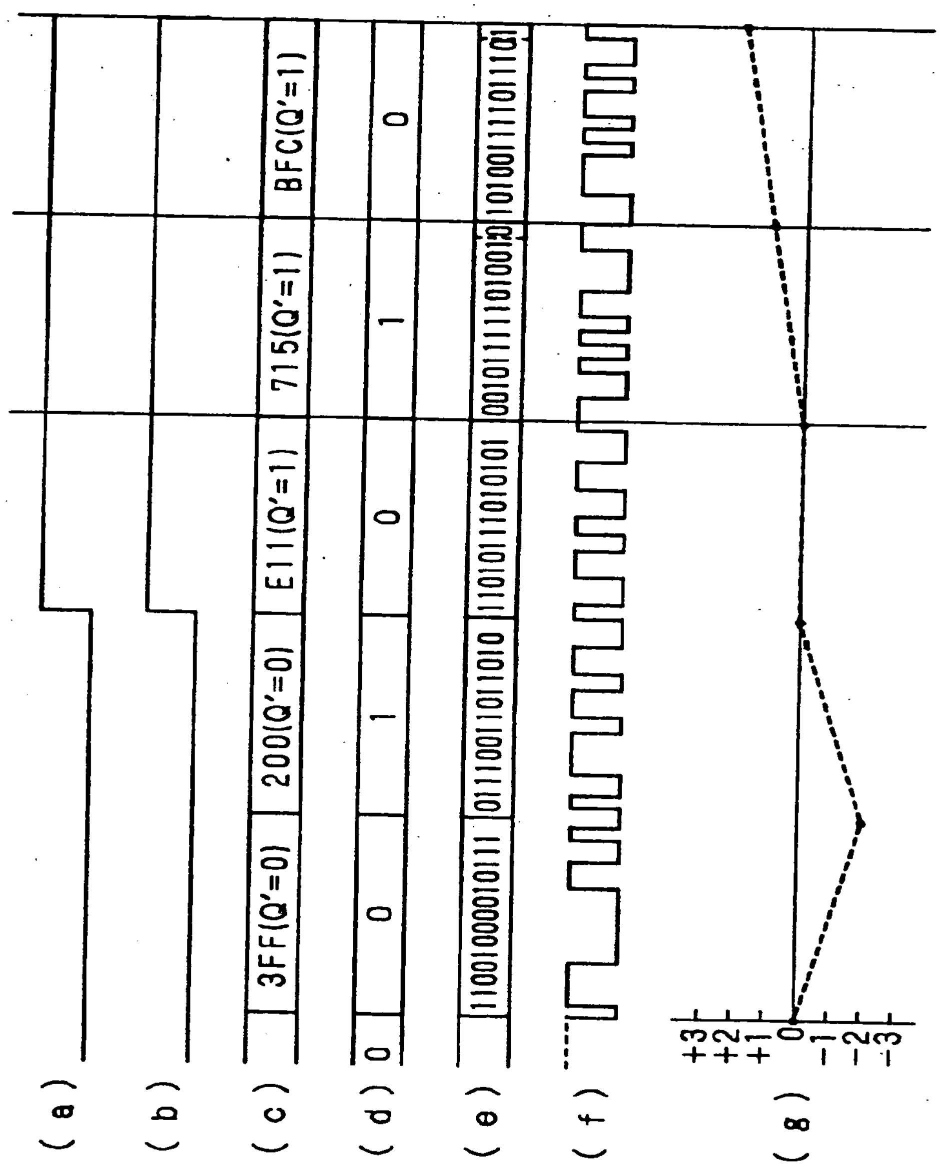

DSV CONTROL SIGNAL
INPUT DATA
12
ENCODER
33
Q'
CDS
Q
34
LSB
14
P/S CONVERTER
43
NRZI MODULATOR
47
RECORD DATA
35
36
37
38
39
40
F·F
SELECTOR
41
Q''
F·F
42
45
Q0~Q3
4
COUNTER
44
L
P0.P1
P2
P3
2
SELECTOR
46
2
2
"01"
"10"
F·F
48
CH-CLK
PILOT AREA SIGNAL

Fig. 50

Fig. 51

DSV	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
DSV'	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
Q'	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
CDS	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
Q"	1	0	1	0	0	1	0	1	0	1	0	1	1	0	1	0

Fig. 52(A)



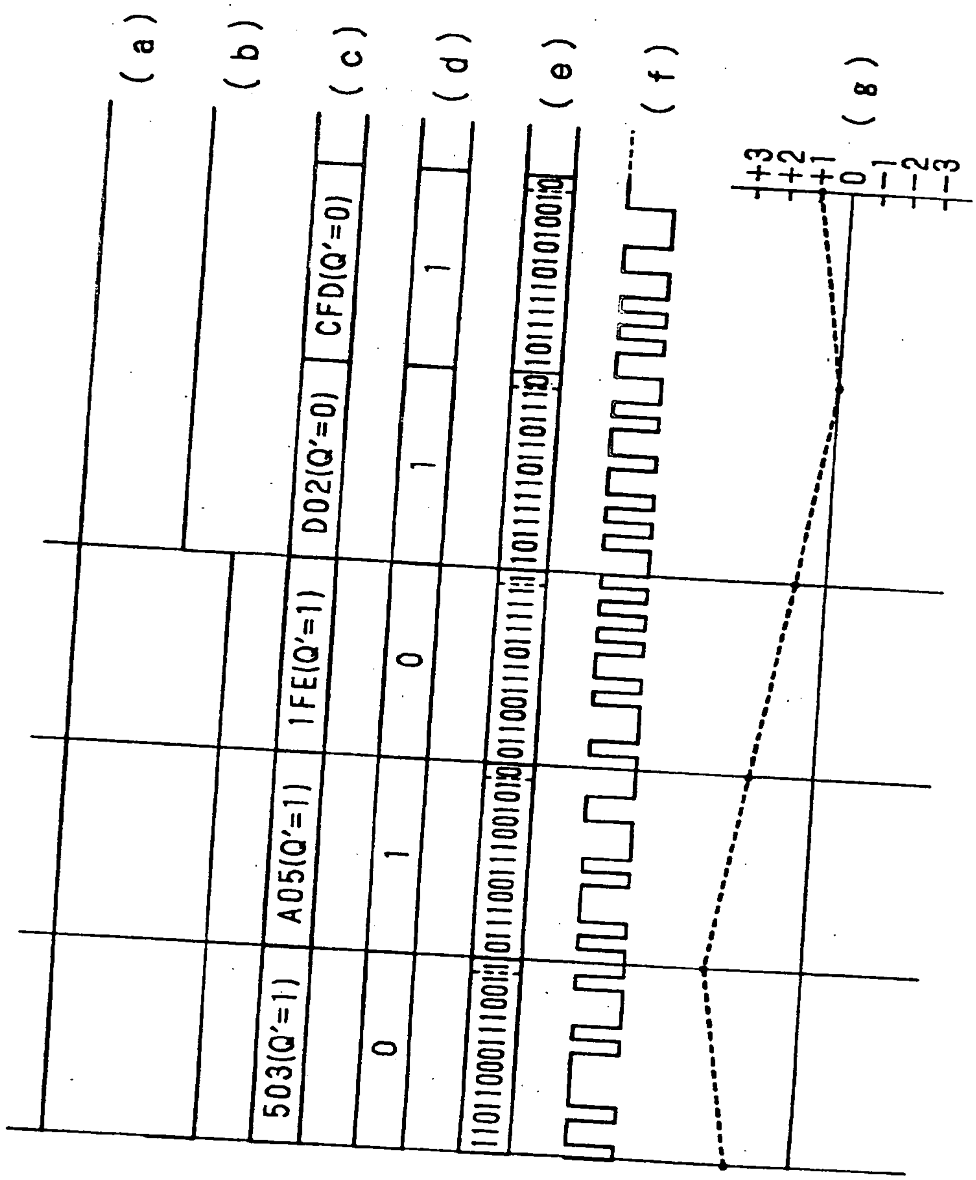


Fig. 52(B)

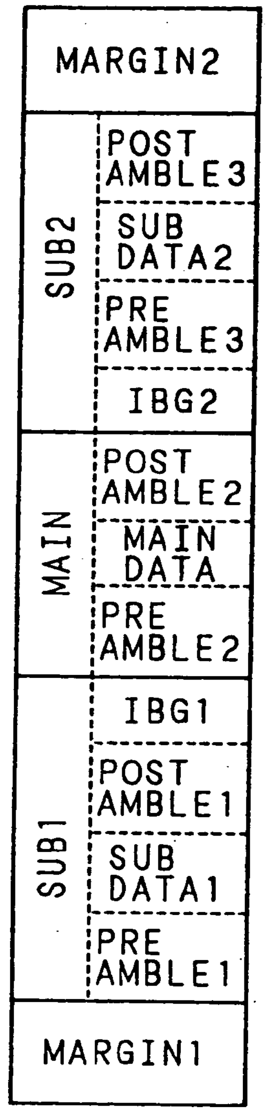

MARGIN2
POST AMBLE3
SUB DATA2
PRE AMBLE3
IBG2
SUB2
POST AMBLE2
MAIN DATA
PRE AMBLE2
MAIN
IBG1
POST AMBLE1
SUB DATA1
PRE AMBLE1
SUB1
MARGIN1

Fig. 53

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European Patent Office
Office européen des brevets

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(54) **Data conversion method and recording/reproducing apparatus using the same**

(57) A data conversion method, wherein a sequence of first r-bit datawords is divided into groups of x bits where x is the least common multiple of r and m, an arbitrary first dataword selected from x/r groups of first datawords is divided into x/m, an m-bit second dataword is formed by appending r/(x/m)-bit data, obtained by dividing the first dataword into x/m, to the LSB or MSB side of one or other of the non-divided first datawords, and the word-converted m-bit second dataword is converted to an n-bit codeword (m < n).

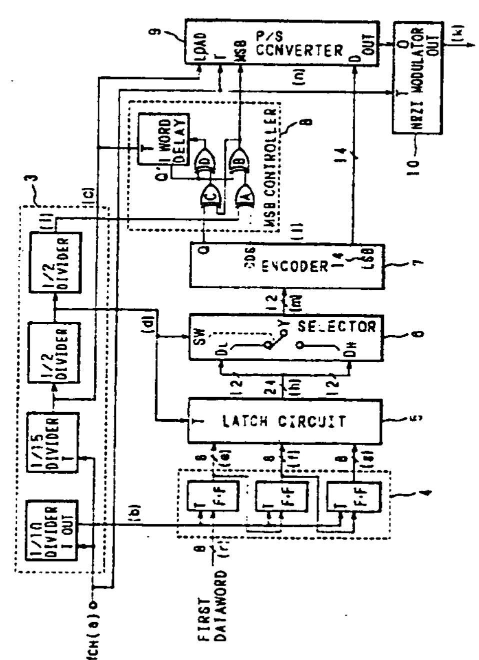

Fig. 27

EP 0 557 130 A3

Jouve, 18, rue Saint-Denis, 75001 PARIS

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EUROPEAN SEARCH REPORT

Application Number
EP 93 30 1251

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	EP-A-0 405 885 (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD) * claim 1; figure 1 *	1,5,11	H03M5/14 G11B20/14 G11B20/12
A	EP-A-0 178 589 (HITACHI LTD) * page 8, line 27 - page 9, line 11; claim 1; figure 7 *	1,5,11	
A	EP-A-0 338 781 (SONY CORPORATION) * column 2, line 34 - column 3, line 14; figure 5 *	1,5,11	
A	FR-A-2 551 277 (SONY CORPORATION) * page 18, line 20 - line 23; figure 4 *	1,5,11	
A	GB-A-2 111 805 (PIONEER ELECTRIC CORPORATION) * claim 1 *	1,5,11	
A	EP-A-0 426 033 (SONY CORPORATION) * claim 5; figures 1,2 *	1,4	TECHNICAL FIELDS SEARCHED (Int.Cl.5)
X	EP-A-0 250 049 (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) * column 6, line 13 - column 7, line 21 * * column 11, line 49 - line 58 *	6	G11B H03M
A	EP-A-0 339 724 (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) * page 4, line 56 - page 5, line 22 *	6,7	
A	EP-A-0 104 700 (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) * claim 1 *	7,8	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 September 1995	Brunet, L

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,

  namely claims:
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,
namely:

see sheet -B-

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respects of which search fees have been paid,

  namely claims:
- ☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,

  namely claims:

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EUROPEAN SEARCH REPORT

Application Number
EP 93 30 1251

Category	DOCUMENTS CONSIDERED TO BE RELEVANT Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	IEEE TRANSACTIONS ON CONSUMER ELECTRONICS, vol.37, no.3, August 1991, NEW YORK, US pages 252 - 259, XP000263193 KEN ONISHI ET AL. 'An experimental home-use digital VCR with three dimensional DCT and superimposed error correction coding' * paragraph 5.2 *	8	
A	EP-A-0 321 314 (SHARP K. K.) * column 4, line 16 - line 27 *	9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 September 1995	Brunet, L

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P : intermediate document

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D : document cited in the application
L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

European Patent Office

EP 93 30 1251 -B-

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 1-5,11: Data conversion method dividing first datawords and re-arranging them into second datawords
2. Claims 6-10 : Data conversion method with special control of the digital sums

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